B Hme A - in present

App. F. IX-4

Previous References 193 C-1 (Seri) File No. 58-30 Serial Nos. 1-9

Later References

Seri Dep. 7b-30.
Seri 58-30-3

? 170(E)

General and Revenue Secretariat.

Serial Nos. Nil

Part B for march 31

SUBJECT.

Note by Mr. M. Shamsuddin Khan, Asstt Supt
Indenter of Agriculture on special duty on re
Organisation of silk industry in Jayan

F 8756 & 7.3.31
to ad dti 1/c

Records Nil

Ks

General and Revenue Secretariat — Serial File No. 5 E of 1930.

	Serial No.	
D. 4605.	1	Letter no. D4-2131-27 dated 30 December 1930 from the Dir. of Ind. forwarding a copy of note given by Mr. Shamsuddin Khan on "Organization of the Silk Industry in Japan" and requesting Govt to get 100 copies of the note printed at the Govt Press, Nagpur. Submitted, with a draft to the Superintendent of Printing. Important portions of the note are marked for perusal. RB. 19.12.30. KD 2 The draft has been a copy of the report. This will have to be returned here for submission to Hon'ble Minister for perusal. 3 Please move the Office note a fair typing, in which can the draft can then a copy of the Press Mg 22/12/30 4 Draft G.O. submitted. RB-24.12.30. KD Some transcript Mg 24/12/30
	2	G.O. no. 6829-30 dated 3rd January 1931 to the Dir. of Ind. and Supt. Govt. Printing sanctioning the proposal of the Dir. to get Mr Shamsuddin's report printed.

NOTE—Contn. Sheet

WD 02553—50,000—GPB—8-7 30

4606

Series File No. 5 8 of 193 0. General and Revenue Secretariat

6. Subs for personal appearance
Important positions of the note
are marked.
KB 5.1.31. 7 For facility of reference
the general observations made by
Mr Shamsuddin Ahmad and his
main suggestions for adoption
in Nepal are indicated in
the form of a Statement put-
up below. Important portions of
the note are marked
KB 7.1.31.
9/1 8 Please put up a copy
draft the Statement, with
a draft-note regarding the reply
to say, that first two points
have been dealt with, and that some
two points which deserve consideration
are given in the appendix. that
for such a step to be kept in abeyance
pending any alteration
taken of the depth being next
enforcements into force,
Mig
9-2-31

7 Draft by Subd
8. 10.2.31 KB
10 for approval and thereafter
Mig
Decision 11. 17-2-31
may be approved
Bk

OFFICE OF THE
THIRD MEETING OF THE COUNCIL
18 FEB. 1931
No. 4910

OFFICE OF THE
FIRST MEETING OF THE COUNCIL
19 FEB. 1931
No. 17

Asst Secretary
Deputy
12 Submit to 1st Member
17/2 Mig 17-2-31 13 Mig
Bk 19/2

Serial No.	
	14 Fund for personal expenditure Dewan. 15/m. 23-2-31 24/2 16 June 24/2/31
2	Q.v. Noted. 87 of 27.3.31 from Dy recording Mr K.S. Menon's report with the request that Govt will be kept informed periodically about the action taken on the report. (The cost of printing amounting to Rs. 100-0-0 will be met from the provision under II Demand and Expdr. Main Heads in the Current year's budget of the Secl. Dept. (Vide Noted. 1074 of Secl. D. 30 of 11.6.31).

6690

B. 1 for bill 1.7.31.

NOTE—Contn. Sheet

WD 02553—50,000—GPB—8-7 30

TELEGRAPHIC ADDRESS:—"INDUSCOM."

GOVERNMENT OF MYSORE.

DEPARTMENT OF INDUSTRIES AND COMMERCE.

GEN. & REV. SECTT. 4608 6/DEC. DEVELOPMENT BRANCH.

In reply please refer to
No. D4.2131/27-28
Encl,

OFFICE OF THE DIRECTOR,
Dated, Bangalore, 3rd December *193*0

FROM

C. RANGANATHA RAO SAHIB, Esq., B.A., B.L.,
Director of Industries and Commerce in Mysore,
(Bangalore, India.)

To

B. NARAYANASAMIENGAR, ESQ., B.A., B.L.,
Secretary to the Government of Mysore,
Development Departments,
Bangalore.

SIR,

I have the honour to submit for the information of Government a copy of the Note given by Mr. K. Shamshuddin Khan, Assistant Superintendent of Sericulture on Special Duty, on the 'Organisation of the Silk Industry in Japan'. I request that the sanction of Government may be obtained for getting 100 copies of the Note printed at the Government Branch Press at Mysore.

I have the honour to be,

Sir,

Your most obedient servant,

Ranganatha Rao Sahib

DIRECTOR.

BV

A Brief Report on the Sericultural Industry
and its Organization in Japan.

****

INTRODUCTORY.

The total area of Japanese Islands is about 133,000 Sq. Miles (exclusive of Korea, etc.) The Country may be termed mountainous. Plains occupy an area of about 10 %. The Kwanto Plain is the biggest, having a population of ten millions. Next to this are Nobi, Kinai, Echigo, Sendai, and Kitami Plains. These latter plains also support a population of about ten millions. These plains are fertile and are very important sericulturally.

The climate of Japan is influenced by periodical monsoons, viz., Summer, and Winter ones. Japan is cold for its latitude and is 'Wet.' There is considerable difference between temperatures of North, Middle, and South. In January in the North, the mean daily temperature is 0.3°C., while in the Middle it is 8.2°C., and in the South it is as high as 11.9°C. In June the corresponding temperatures are 18.3°C. 24.5°C., and 26.1°C. This has an important bearing on the sericultural operations of each Province. Even in the same latitudes there are considerable differences in the climate according to mountainous, and Plain Countries.

There is considerable snow fall in the winter in Northern Districts, while in the middle regions the snow fall is appreciable, and in the South it is almost nothing. On the Pacific Coast it is less, and on the Western Coast it is comparatively more. Therefore, in the Northern and Sub-Northern portions of the Island mulberry is either "Middle," or "Tree" System, while in the Central and Southern Regions it is almost entirely "Bush" system.

RAIN-FALL.

All over Japan rain-fall is evenly distributed throughout

throughout the year favouring agricultural operations. This factor is very important in Sericultural Economics as mulberry is cultivated without expenditure on irrigation. This cuts down costs of production of raw silk considerably. The annual average rain-fall in the South varies according to places from 80" to 100", in the Middle and Sub-Middle Districts it varies from 65" to 85", and in the North it varies from 60" to 80".

HUMIDITY.

Japan's geographical position is responsible for its humid condition. The annual average percentage of humidity in the South is 79, in the Central regions it is 74, and in the Northern region it is 80. In the South, rainy days are 167 per year; in the Central 139, and in the extreme North 192.

Sunny days in Japan are few. On an average 150 days are rainy or snowy and the remaining sunny and cloudy.

FROST.

Frost often affects mulberry in Japan. It generally occurs between the 12th of April and 16th of May, according to situation of Districts. It is almost regular for the same locality, year in and year out.

POPULATION.

The total population of Japan Proper is about six crores. The rate of increase in the last five years was 6.7%, or an average increase of seven lakhs and a half per year. The density of population is 410 per Sq. mile. The ratio of males to females is 101 to 100. Urban population is 14.8 %, while the rest is rural. Agriculture is the main occupation of the rural population.

ADMINISTRATION, ETC.

Japan is a Constitutional Monarchy. It embodies the cult of Imperial Ancestor. The Emperor is advised by a

Privy

Privy Council, and in times of emergencies he consults and acts on the advise of "Genro" or elder Statesmen, so named by him. There is a House of Peers and a Lower House, corresponding to House of Lords and House of Commons in England The Lower House is elected and the Prime Minister with his Cabinet is responsible to the House. Each Minister has several Departments in his charge. There are no direct Departmental Heads. The administration is carried by the Ministry directly, through the Governors of the Prefectures. Each Department of the Ministry has a Secretary to whom all papers are submitted by the Prefectural Governors. Japan Proper is divided into forty-seven Prefectures. Each Prefecture is in charge of a Governor who is directly the subordinate of the Home Minister, but is responsible to the several Ministers in the several Departments. He has three assistants of the higher rank. One of them is the Vice-Governor, who has the charge of the administrative section, and Development Departments, such as - Agriculture, Sericulture, etc., while for Education, there is a special officer, and for Police, there is a Police Officer. Judiciary is independent. The Governor has a non-official Advisory Council. Sericulture is under the Ministry of Agriculture and Forestry, excepting the three Sericultural Colleges and several Sericultural Schools, which are under the Education Minister.

THE POSITION OF SERICULTURAL INDUSTRY IN JAPAN.

The total area of arable lands is 1,49,09,724 acres, being 16 % of the total area of lands. Paddy fields occupy 52 % of the total area of arable lands. Mulberry comes next to paddy in extent, being about 15,00,000 acres. It occupies one-tenth of the total arable land or one-fifth of paddy. The money equivalent of annual production of paddy is Y.1,835,000,000 while that of raw silk is Y. ~~900,000,000~~ 900,000,000 i.e., 50 % of that of paddy. Thus, mulberry is of very great economic importance in agriculture and has a great national value. Again, if

trade

trade figures are analysed we find that out of a total export trade of about two billion and a half, raw silk and its products, etc. contribute nearly 40 %, i.e., about nearly a billion Yen annually. Without her raw silk trade, Japan would be nowhere in International Commerce. It is this factor combined with its 'Cottage' aspect that has made Japan to devote full attention to the development of Sericultural Industry in all its aspects. Mysore on a small scale can hold the same position as there are several points of resemblances. Of late, in Japan, cotton textiles have shown a rapid advance, but, the existence of cotton textiles depends upon imports of foreign cotton. Whereas, silk industry is entirely a home one.

POSITION OF JAPAN'S SERICULTURAL INDUSTRY IN THE WORLD.

Out of a total production of 420,012,000 Kgs. of cocoons, Japan produces 341,697,000 Kgs., or nearly 80 % of the total output (leaving China out of account), while Italy is responsible for 50,000,000 Kgs. or about 12 % of the total, and France, for 0.80 %. In 1927 the total out-put of the world of raw silk was 54,643 metric tons. Of this Europe contributed 5,530 metric tons, while Asia was responsible for the rest, viz., 49,113 metric tons, Japan contributed 37,653 metric tons, while China was responsible for 9,675 metric tons. Italy, the premier silk producing country of Europe was responsible for 4,627 tons. Japan, in 1927 produced 69 % of the world's out-put, and 84 % of her production was exported, 94 % of which was to the United States of America.

~~Again~~, In 1915, the total out-put of world's raw silk was 29,300 metric tons. Japan contributed 14,080 metric tons, which increased to 37,653 metric tons in 1928, or, her (Japan's) production has been trebled, while that of the whole world has nearly doubled during the same period. In 1868, Japan produced only 20 lakhs of pounds of silk, in 1893, she produced nearly one crore of pounds, while in 1927, the total of Japanese production rose to 7½ crores of pounds. This means, that within a

period

period of sixty years, Japan's out-put increased by thirty-five times. This phenomenal growth is due to increase in mulberry acreage, rearing of summer and autumn crops, introduction of artificial hatching, improvement in silk-worm races, genetical work, improved methods of rearing silk-worms, better methods of reeling, scientific research, universal organisation, technical education, increase of raw silk exports especially to the United States of America. In a word it is due to rationalisation of the Sericultural Industry in all its phases.

NUMBER OF FARM HOUSE-HOLDS, ETC.

The total number of Farm households at the end of 1928 was 5,575,881, being 47 % of the total number of households in Japan. Of this 71 % are engaged in agriculture alone, while the remaining are engaged ~~both~~ in agriculture together with other occupations. Sericultural households at the end of 1928 were 2,165,265, showing an increase of 3 % over 1927 figures.

GENERAL SERICULTURAL STATISTICS.

In ~~1928~~ 1918, the total area under mulberry was about ~~12½~~ lakhs of acres which gradually rose to 15 lakhs of acres in 1928 ~~Or~~ or an increase of 20 % in ten years. In 1922 the number of nursery owners of mulberry plants was 51,799 and in 1928, it rose to 199,183. During the same period the total quantity of plants (including seedlings, graftings, root-suckers, layers, and others) increased from 223,863,951 to 555,042,238. The corresponding value was Y. 3,293,106 and Y. 4,644,925. respectively In 1926, the number of plants used was as high as 924,000,000 with a total value of Y. 15,288,566. The above figures are indicative of the value set on good mulberry seedlings, etc.

In 1918, the number of seed makers was 10,790, which fell down gradually to 7,195. During the same period the total number of disease-free layings produced was 933,523,740 and 902,285,861, respectively. In 1918, the total number of "Reproductive Eggs" manufactured was about three crores of disease-free layings, while industrial

egg

eggs formed about ninety crores. In 1928, the quantity of "Reproductive" eggs used was about 1 crore and 82 lakhs of disease-free layings and that of industrial eggs, 88 crores. It is seen that though the area under mulberry increased, the total quantity of eggs used decreased. The total quantity of cocoons produced in 1918 was 68 million Kwan (1 Kwan = 8.27 lbs.) and in 1928, it was 93 million Kwans. This state of affairs is due partly to improvement in seed and silk-worm races, and partly to more people having taken up rearing of summer and autumn crops, as artificial hatching became more universal.

In 1928 out of a total production of 93,849,090 Kwan of cocoons, 80,979,196 Kwan were good cocoons, while double cocoons formed 8,388,901 Kwan and waste and inferior cocoons 4,480,993 Kwan, or, 86 % were good cocoons, 8.6 % were double cocoons, and 3.4 % were inferior and waste cocoons. 53 % of the cocoons are from Spring Crop, while Summer and Autumn Crops are responsible for 47 % of the total out-put of cocoons.

The total number of rearers in 1918 was 19,10,769, while in 1928, it was 21,65,265.

RAW SILK PRODUCTION.

The total number of reeling establishments in 1918 was 255,750, with 626,740 basins. In 1928, the corresponding figures were, 76,090, and 435,735, respectively. This indicates that reeling moved more towards factory system and filature type from cottage and foot reels. The total quantity of silk produced in 1918, was 5,795,542 Kwan (1 Kwan = 8.27 lbs.) (Value - Y. 526,708,280) and in 1928 it rose up to 10,584,232 Kwan (Value - Y.835,467,904.) The total quantity of waste of all denominations rose from 2 million Kwan to 4 million Kwan, with a value of about Y. 22,000,000. In 1918, the number of filatures was 4,639 (with 275,760 basins) producing a total quantity of nearly 5 million Kwan of raw silk. In the same year the number of Foot-Reel and other establishments was, 206,267 (with 281,977 basins.) These establishments produced nearly 6 lakhs of Kwans of silk, with a total value

of

of fifty million Yen. In 1928, the total number of filatures was 3,509 only, while the number of basins increased to 318,540. This means, that the average size of filatures increased from 60 basins each to 90 basins. The real state of affairs is that almost all joint-stock filatures are above 250 basins, while Co-operative Filatures are never more than with a capacity of 60 basins. The larger filatures are all above 500 basins. By the same year, the number of Foot-Reel and other establishments had gone down to 62,088 with only 85,363 basins. The above figures clearly indicate how rapidly factory filatures replaced old home reeling establishments.

(3) The number of Doupions Establishments was, in 1928 - 10,493 with 31,832 basins and with a total production of 654,815 Kwan of double cocoon silk as against 44,844 establishments, 69,003 basins, 466,954 Kwan of dupions silk in 1918. A fairly large quantity of Doupions silk is imported into India and sells cheaper than Mysore Raw Silk.

SILK WASTE, ETC.

The total quantity of silk waste of all grades in 1918 was 2,094,592 Kwan (1 Kwan = 8.27 lbs.) while in 1928, it rose to 3,940,601 Kwan. For every 2.76 lbs. of silk in 1918 1 lb. of waste was got. In 1928, the ratio was 1 to 2.7.

(4) Of late larger quantities of silk waste are used in Japan for spinning, while exports are proportionately reduced.

The total number of Operatives employed in reeling establishments in Japan is 515,504.

ORGANIZATION.

Sericulture proper is in charge of Agricultural and Forest Ministry. Sericultural Education is in charge of Education Ministry. The Agricultural and Forest Ministry has one Bureau for Sericulture, which has two Sub-Bureaus.

Sericultural

Sericultural Bureau.

I. Sub-Bureau for Sericulture Proper. This Sub-Bureau has charge of:-	II. Sub-Bureau for cocoons and Filatures. This Sub-Bureau has charge of:-
(1) Imperial Sericultural Station.	(1) Filature Industry.
(2) All Prefectural Experimental and Inspection Stations.	(2) Conditioning and Test Houses.
(3) Sericultural Co-operative Societies.	(3) Cocoon Drying Societies.
(4) Raw Silk Association of Japan and Imperial Sericultural Association of Japan.	(4) Filature Guilds.
(5) Encouragement connected with the above.	(5) Co-operative Filatures.
	(6) Encouragement connected with the above.

Besides the above, there are two Committees, viz., (1) Committee for improvement of Sericulture, (2) Committee for Store Houses and Drying of cocoons. These are non-official bodies with expert advisors, and presided over by the Agricultural and Forest Ministry. There are similar committees in prefectures where sericulture is in existence.

F I N A N C E S.

The total budget for 1927-28 (in Japan) was Y. 1,759,000,000. The apportionment of expenditure among the departments was as follows:-

		Percentage against total.
1. House-hold	- Y. 4,000,000.	0.229 %.
2. Foreign Affairs.	- Y. 20,000,000.	1.145 %.
3. Finances.	- Y. 416,000,000.	20.000 %.
4. Interior.	- Y. 265,000,000.	13.000 %.
5. War.	- Y. 212,000,000.	10.000 %.
6. Navy.	- Y. 256,000,000.	11.000 %.
7. Justice.	- Y. 37,000,000.	0.210 %.
8. Education.	- Y. 140,000,000.	7.000 %.
9. Agriculture and Forestry.	- Y. 49,000,000.	2.500 %.
10. Commerce and Industry.	- Y. 11,000,000.	0.500 %.
11. Communications.	- Y. 344,000,000.	19.000 %.
12. National Debt Consolidation.	- Y. 286,000,000.	16.000 %.

BUDGET FOR SERICULTURE.

This is divided into two, viz., Imperial and Prefectural. Imperial grants are defrayed by National Treasury, while Prefectural Grants are met by Prefectural Governments.

Imperial

Imperial Budget for Sericulture.

(a) 1.	To Improvement of Mulberry.	- Y.	22,600.
2.	To Improvement of Cocoons.	- Y.	37,000.
3.	To Investigation of Diseases.	- Y.	173,000.
4.	To Aid to Raw Silk Association.	- Y.	13,000.
5.	To Aid to Straw-wares, Drying of cocoons.	- Y.	604,800.
6.	To Imperial Experimental Station.	- Y.	294,183.
7.	Silk Examination.	- Y.	438,233.
	T o t a l.	- Y.	1,582,816.

(b) Prefectural Budget for Sericulture.

1.	To Improvement of Mulberry.	- Y.	560,000.
2.	To Improvement of Sericulture.	- Y.	324,000.
3.	To Improvement of Eggs.	- Y.	60,000.
4.	To Improvement of Silk.	- Y.	231,000.
5.	To Seed Inspection Stations.	- Y.	2,412,577.
6.	To Sericultural Institutes or Stations.	- Y.	1,754,681.
7.	To Silk Examination.	- Y.	63,065.
8.	To Sericultural Education.	- Y.	644,454.
9.	To Miscellaneous.	- Y.	152,671.
	T o t a l.	- Y.	6,202,448.
(c)	Three Colleges.	- Y.	512,000.
	GRAND TOTAL.	- Y.	8,297,264.

(Or nearly a Crore and a quarter of Rupees.)

As compared with the total expenditure, the actual realisations of money is negligible. The policy adopted is that of encouragement and improvement of the industry. This is the reason why no stress is laid on actual realisations. A large amount is spent on Inspection Stations which exist primarily for inspection of seed and control of diseases. The money spent on rearings is almost unremunerative as layings prepared out of seed cocoons produced are distributed free to seed-makers for seed cocoon rearings. Sericultural Educational Institutions are maintained to train staff for the various Stations and to disseminate knowledge. Money spent on experiments practically brings forth no realisations. Filatures or Reeling Establishments are installed not for commercial, but for educative purposes

purposes, or for assisting the several purchasers of cocoons in stabilising cocoon prices on scientific lines by conducting reeling tests, which enable the purchaser to pay on actual reeling quality and renditta of cocoons.

EXPERIMENTAL AND INSPECTION STATIONS.

There are two kinds of Experimental Stations, viz., Imperial Sericultural Station, and Prefectural Experimental (Sericultural) Stations. There is one Imperial Sericultural Station in Tokyo, and has six branches in six different Provinces. This is directly under the control of the Agricultural and Forest Ministry. There are forty-seven Prefectural Stations, one for each Prefecture. These Stations are under the direct control of the Prefectural Governor who is responsible for all sericultural work in his Prefecture to the Minister for Agriculture and Forestry. Under the Sericultural Law of Japan, each Sericultural Prefecture is required to have an Inspection Station with several subordinate Stations for inspection of seed and for control of diseases. There are forty-seven Prefectural Inspection Stations. The Experimental (Prefectural) Stations may have the prefectural Inspection Stations under their control, or the Inspection Stations may work in direct subordination to Sericultural Bureau of the Governor's Office, according to local circumstances and administrative conveniences.

IMPERIAL EXPERIMENTAL STATION.

This Station exists mainly for research work in all subjects connected with sericulture, improvement of silkworm races, etc., Genetical work, Improvement of mulberry varieties, improvements, etc. in Filature work, research work in chemical aspects, cold storages, etc. One more important function is to act as a consultative body in all sericultural matters for the Experimental Stations of prefectures.

This Station has six branch stations in six different provinces for experimental work, and for preparing "Original" silk-worm seed ~~for~~ of new races and breeds for distribution to prefectural stations. Some of these

stations

stations are used for testing and verifying laboratory scale results on a large scale.

The Imperial Station has six Departments, Viz. -

(1) Mulberry Department. - This Department carries on research work and experiments connected with mulberry, distributes newly evolved mulberry varieties to different prefectures. It arranges for Extension Lectures on mulberry cultivation. It is in charge of an expert who is a scientist. His classical research work is on Mulberry Cytology.

(2) Department of Biology. - This has three distinct branches, viz., Genetical, Physiological (including work on voltinism), and a branch for silk-worm races. This branch is similar in function to Mulberry Department. The one great work done in Genetical Section was to reduce the number of silk-worm races and to improve them and to evolve new races by Genetical Methods. Its rearing branch rears worms of new varieties and distributes to prefectural stations for further ~~multification~~ multiplication and distribution to seed-makers.

The recent classical research work done in this section comprises of work on silk-worm chromosomes and Gynandromorphs. It provides working formulae in silk-worm hybridisation work to experts of prefectural stations. The section connected with silk worm races concentrates attention on comparative data concerning various silk-worm races, both for scientific and practical purposes. The physiological branch carries work in pure and applied physiology of silk-worms, ~~Voltinism~~ Voltinism branch carries work on voltinism. Much of the work done in all these branches is of a scholarly and scientific nature.

(3) Department of Pathology. - This department has three branches, viz., Bacteriological Branch for ~~Pebrine~~ Flacherie etc, Mycological Branch (both for silk-worms and mulberry.) Extensive experiments are being conducted on "Ionic values" of silk-worm suffering from flacherie and allied diseases, and on bacteria found in silk-worms suffering from flacherie. The exact causes of flacherie are being diagnosed. There is much

much valuable information on this subject.

Pebrine. - After Stempell and Kudo important research work in pebrine has been done here re' nature of polar filament of "Noseme Bombycis." The Mycological Section does work in silk-worm and mulberry fungus diseases. The pathological department suggests ways and means of prevention of silk-worm diseases, as also of mulberry.

(4) Department of Filature. - All experiments and researches in reeling technique and allied subjects are carried on in this Department, as also in several kinds and types of filature basins. For the past five years this branch has been doing experiments in the classification of cocoons (Japanese). The results of these experiments which are elaborate will be published next year. There is a mechanical section which carries on research work and experiments in all kinds of machinery connected with reeling and testing of silk. Harada's denier graph is the most accurate instrument constructed for recording deniers for research and experimental work. There is one more branch for experiments and researches in physical properties of raw silk. This section has the most elaborate and accurate set of instruments for work. All these were constructed by the expert himself. The "Kilcha" weighing balance being the most ingeneous instrument weighing accurately to one-thousandth of a milligram.

(5) Department of Chemistry. - This branch carries on experiments and researches on all subjects connected with sericulture. The physiological-chemical work done here is one of the outstanding contributions on the nutrition of silk-worms. A large amount of chemical work has been done on "Reeling" silk. Manures form a good portion of the work. Analyses of Sericultural products is one of the routines. Very valuable work has been published in Japanese Language in this section.

Department

(6) Department of General Affairs. - This Department deals entirely with the administrative work.

There are altogether 17 experts, for the various Departments in addition to assistants and other workers.

There is a practical course of filature training to train experts in cooking cocoons (male attendants) and to train instructresses in filature technique. The total number of trained attendants since 1915 is 400 male and 1,000 female attendants. Short course lectures are now and then delivered for the benefit of filature workers. Lectures on mulberry cultivation and silk-worm rearing are given from time to time.

All the laboratories are well equipped in scientific appurtenances. There are up-to-date air and humidity conditioned rooms for rearing worms for bacteriological and genetical work. All departments are well furnished with libraries and scientific magazines and periodicals. No students are admitted for training as the Institution is maintained purely for research and experimental work. ~~Exception to a certain extent was made in Mr. Govinda Rao's and my case.~~

PREFECTURAL EXPERIMENTAL STATIONS & INSPECTION STATIONS.

Each prefecture has an experimental station with branches wherever necessary. This works under the Vice-Governor who has a Bureau for Sericulture. The Bureau Chief is an expert in sericulture or a junior civilian. For each section there is a technical assistant in the Bureau Office. The Experimental Station is directly under a Director who is a Sericultural Expert of fairly long standing, a Graduate of a Sericultural College. Generally speaking the work is divided into (1) Sericulture (includes experimental rearing work in genetics, diseases, rearing of silk-worms for original seed, and preparation and examination of "Original Seed,") (2) Mulberry Section for growing mulberry for rearings, for experiments, and a chemical section for work on chemical sides, (3) Sericultural

Co-operation

Co-operation for administration, etc., of co-operation work, (4) Filature for experiments in reeling and for testing of cocoons of various Co-operative Societies, (5) Administrative branch for general office work, and for encouragement connected with the Industry. Generally speaking each branch has an expert who is responsible for all work in his section. The number of assistants in each branch depends upon the magnitude of the work turned out.

S T A F F.

D i r e c t o r.

(1) Sericulture.

One Chief Expert, one Expert, and 2 to 3 Asst. Experts for each branch, viz., Pathology, original seeds rearing, preparation of seeds, besides assistants and temporary assistants in season.

(2) Mulberry

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Besides the work already mentioned, the experimental station and other trains students in rearing ~~together~~ work. Lectures to students are delivered from November to April, i.e., in the off-season. In the off-season, the mulberry department and other Departmental staff check statistics collected by the subordinate Inspection Stations.

Filature Section. - The filature besides carrying on experiments, and sending lady instructresses to various filatures for improving reeling technique carries on cocoon quality tests, and issues certificates.

Cocoon markets in Japan are ruled by what is called "Kakeme" which means relative value of cocoons. Suppose the Silk Exchange in Yokohama declares the price of silk at Y. 1,350.00 per picul (one picul has 100 kin and each kin is equal to 160 Momme = 1.33 lbs. i.e., 1 Picul = 133 lbs.), the filatures offer Y. 1,000.00 as the total price payable for that quantity of cocoons which produces 100 Kin of silk, i.e., 1 Picul, deducting Y. 350.00 as costs of production, etc.

production, etc. This Y. 1,000.00 is divided by 16 (as each Picul consists of 16 Kwan, and one Kwan 8.27 lbs.) The quotient, viz., 62.5 is the "Kakeme" or the Relative Index. If cocoons on visual inspection are supposed to produce 10 % of silk, then the price of 1 Kwan of cocoons is calculated as:

$\frac{\text{"Kakeme"} \times 10}{100}$ = Price per Kwan of cocoons. Substituting - $\frac{62.5 \times 10}{100}$ = Y. 6.25. If the percentage of silk is supposed to be 12, then the corresponding price per Kwan of cocoons is - $\frac{62.5 \times 12}{100}$ = Y. 7.5 and so forth.

It may, in passing, be mentioned that "Kakeme" is governed by silk prices, quality of cocoons, and costs of production of silk. It is assumed while transacting business that a rate of Y. 6.25 will be paid if cocoons produce 10 % of silk on reeling. Should the cocoons on actual reeling give only 9 % of silk, then the prices to be actually paid would be only - Y. $\frac{62.5 \times 9}{100}$ = Y. 5.625 per Kwan and so forth. The Government Filatures carry test reeling of 400 Momme (1 Momme 3.75 grms.) of cocoons and issue reeling certificates to the institution or parties that sent the cocoons for reeling. The purchasers pay the price of cocoons as per tests got. This is a very important work. The Experimental Station Filature in Kumagaya carries tests for 10 to 11 thousand lots of cocoons a year.

A Prefectural Station may have a few Subordinate Experimental Stations for work. In brief, the Experimental Station conducts experiments to find out suitable varieties of mulberry and silk-worm races for its jurisdiction, and carries on research work, supplies a portion of 'Original Seed' to seed makers, popularizes "Encouragement breeds of silk-worm races," supplies "Encouragement varieties of mulberry" to nursery owners, offers advise and guidance to Sericultural Guilds of various denominations, carries on economic inquiries, acts as an advisory body on the various institutions, to individual sericulturists, tests cocoons in filature, trains students, etc

- (N.B. - Encouragement Breeds or Varieties in silk-worms and

and mulberry, are such breeds that have proved to be very good and profitable in particular prefectures. These are determined by a large number of experiments before hand. Each prefecture may have its own Encouragement Breeds in preference to other varieties.)

INSPECTION STATIONS.

The Sericultural Law of Japan requires that all silk-worm eggs to be reared, whether cellular or industrial should be microscopically examined, and certified to be disease-free as per prescribed tests, etc. under law, exception being made in case of research, ~~and~~ experimental and education work. This necessitates existence of inspection stations in all prefectures with sufficient staff to carry on microscopic examination of all layings prepared by the seed-makers. Each prefecture has one inspection station, and each County has one subordinate inspection station. (In Japan prefectures are divided into Counties, and Counties into villages. Prefectures are comparatively smaller in area to our districts. Generally a prefecture has 8 to 10 to 12 Counties according to its extent and population.) The prefectural inspection station is under charge of a Sericultural Expert of experience. In many a place it is under the control of the Director of the Experimental Station. In such cases, the work of the two institutions is not allowed to overlap, but is kept distinctly separate. The Prefectural Inspection Station controls in technical and administrative matters its County Stations. The County Stations may have subordinate Stations as well, where the jurisdiction is big.

The Prefectural Inspection Station has one Director and should The Director be the officer of the Prefectural Experimental Station also, a separate Expert is always in charge of work of the Inspection Station. There are a number of assistants both for technical and office work. This Station does not only ~~the~~ supervise ~~the work of the prefectural~~ administrative work, but also ~~does carry~~ Carries on microscopic examination of layings

layings of the Head Quarters County. Each County Station is in charge of an officer of the rank of an Expert, assisted by several assistants and an office. The most important work that is done is microscopic inspection of moths of all seed-makers in the County. The seed-makers in a County are all subject to control of the County Station. A seed-maker is allowed to rear only cellular layings supplied by Government Experimental Station, or cellular layings prepared by himself. The Experimental Station of the prefecture generally supplies about 30 % of the total requirements of the "Original seed" to the seed-maker. As the rearings are in progress the Expert or his staff inspects the rearings from stage to stage for diseases, etc. When the rearings are approved by the County Stations as fit for 'Seed' purposes, then the seed-maker harvests cocoons for seed, and prepares seed according to rules prescribed under regulations. During the course of preparation of seed the County Station inspects the operations. When all the operations are over the seed-maker carries all moths in regulation cellules, and also the egg cards, or laying sheets, in the prescribed manner according to breed, crop, voltinism, etc., and deposits them in the Inspection Station of his County. This operation commences in the end of July to August. The moths and layings are all classified and examination commences. There are two kinds of examinations, viz., Cellular and Percentage Examination. In the cellular examination all the moths are examined for pebrine, while in the percentage examination, ten percent of the moths ~~are~~ is examined, and should this quantity satisfy the required test, viz., of pebrine being less than 1 % in the 10 % of the moths taken for examination, then all the layings are certified "Disease-free," and on the other hand, if the incidence of pebrine is above 10 % for the whole lot, cellular examination of that lot of seed is arranged for. In Japan microscopic examination is carried only for pebrine, as that is the only heriditary disease, and as bad rearings are eliminated during the course of rearing. After all the examination is over, the

bad

bad layings are rejected and certificates or seals are affixed. The layings are delivered to the respective seed-makers who arrange for "Cold Storage" and subsequently arranges for sales directly or through seed-brokers.

The Inspection Station enforces all Sericultural Laws, especially relating to Pebrine and 'Fly' diseases, the latter being common in Japan in the Spring Season. It advises sericulturists in all sericultural matters, collects sericultural statistics, supervises, encourages, and forms sericultural guilds of all denominations, inspects mulberry nurseries and controls the work of its sub-stations.

E Q U I P M E N T.

Each County Inspection Station has a few centrifuges for tests, re' pebrine. This facilitates work very much as silk-worm moth fluid gets concentrated and pebrine is easily detected if any at all is present. There are one or two circular moth crushing machines, generally of the big size. This device facilitates moth crushing work considerably, as also that of preparation of slides, and is more hygienic. Besides, chances of error are few. This machine is worked by a small motor and has water pipe connections. Each station has 20-30 microscopes on a minimum, while bigger Inspection Stations may have as many as 40-50 microscopes. These microscopes are of the common type we have here. Each examiner has a separate table and chair for her work. All the seats are serially and sideways arranged and the hall has a large number of windows to admit of plenty of light for microscopic examination. The examiners are not officials, but <u>are girls who hold licensed certificates as examiners</u>, and are employed during the season only paying Y. 0.70 to 0.90 per head daily. They work from 8 to 12 A.M. and again from 1 to 4 P.M. The girls employed for arranging moths serially, etc. in the mortars and to mark out in the rough register concerned, also the girls working at the moth crushing machines, slide, etc., cleaners, are all appointed for the season and dismissed so soon the

work

work is over. There is an assistant in charge of the store of egg cards and moth cellules. He attends to deliveries from his branch. The receiving assistant supervises work of the "Consigners" of moths in mortars, of girls working at the machine, of girls employed for cleaning slides, etc. and of these engaged in transport of slides, etc.. A girl that consigns moths from cellules to mortars attaches the 'Serial number' slip to the mortar holder. This slip is attached finally to slide holder. The examiner ticks the results of the examination and passes her slides to the "Supervisor", who checks 10 % of all the slides. Thus, a group of 4 - 5 microscopes has a supervisor for technical check of the work.. If the original examination is found unsatisfactory, the examination is done once again. After the final check the record slip is passed on to the technical assistant in the office who groups together all such records slips, consolidates, and prepares a statement of examination of each seed-maker. Another assistant receives this statement and gets all the rejected layings removed according to this statement, and after obtaining final orders of the officer of the Station 'Seals' or certifies as "Passed" or "Unpassed" according as the percentage of pebrine is below the one admitted under Law or above it. After all examination is over and records are complete and certificates are passed, the seed-makers are notified of the same. They remove the layings to their individual grainages.

Every Inspection Station has a sufficiently big hall for microscopic examination, and a cellar for depositing egg cards, with suitable racks and holders for the sheets. It has a room for conserving moth cellules. There is a separate room for examining egg-cards for minor defects, such as - poor layings, etc. for removal of rejected layings. The office has a big reception room for meetings or work with the seed-makers. The Inspection Station may be combined with a sub-experimental station, under the supervision of the same officer. In no case is the work of the one allowed to overlap the work of the other. The work of the sub-experimental station

station is just the same as that of the Prefectural Station on a small scale.

The subordinate inspection stations are under the control of the County Inspection Station in each County when they exist. Generally there is an assistant only to look after the work. He tours round the villages, inspects and guides rearings of the seed-maker, visits guilds, collects cocoon-market information, makes notes of crop conditions, collects data and statistics. Since his jurisdiction is limited, and since facilities for touring exist, his iteneration is very satisfactory. Being an educated and well trained man his work is dependable.

PREFECTURAL CONTROL STATION, ETC.

(a) Office work.	(b) Technical and Executive work.	(c) County Station.
Manager 1. Technical Assistants 2-4, according to size and work of the prefecture. 2-4 clerks. Work is administrative and compilation and consolidation of all statements and statistics, etc. Is in immediate charge of an expert or the Director.	1 Director. 1 Expert 2 Asst. Experts. 2-6 Assistants. 2-6 Clerks.	(As in b.)

Inspection Station popularises the several Encouragement Breeds and Varieties of silk-worms and mulberry suitable for the locality as advised by the Experimental Station. It starts cocoon-drying guilds and helps the guild in its technical work. It practically attends to all work connected with Sericultural Law, several ordinances, orders, and measures for the development and progress of the industry in its jurisdiction. It is in fact the executive organ of the Sericultural Organization of Japan.

SERICULTURAL EDUCATION IN JAPAN.

College Education. - There are three Sericultural Colleges, one at Tokyo, one at Kyoto, and one at Uyeda. The minimum qualification required for admission into these Colleges is graduation from a Middle School (to pass out of a Middle School in Japan it takes

eleven

eleven years and Middle School Education corresponds to our High School Education, and in fact its standard is higher than that of our Secondary School Leaving Certificate Course.) Admission into these Colleges is by an open competetive examination in several subjects. The number of seats in each College is restricted as definite accommodation is to be provided for practical work in Chemistry and rearing, bacteriological and anatomical laboratories. These Colleges are under the Ministry of Education.

There are three courses, viz., Moriculture, Sericulture, and Reeling in all the Colleges. Uyeda College has an additional course for silk-waste spinning. Each course is for three years. The common general subjects taught are Japanese language, English, Physics, Chemistry, Algebra, Geometry, Trignometry, Botany, Zoology, Histories, and Geography, German or French, Entomology, Soils and manures, Co-operation, Rural Sociology, Conditioning and Testing of Silk, Silk Market and Exchange. Rearing of silk-worms, mulberry cultivation, reeling, Sericultural Economics, Grainage work, organization of Sericultural Industry are common subjects. Sericulture Course has a higher standard in Genetics, Silk-worm rearing, Anatomy, and Physiology of silk-worm. The reeling or filature course pays more attention to reeling and filature technique. Similarly moriculture pays more attention to moriculture. The silk-waste spinning course in Uyeda gives actual practical training in silk-waste spinning and machinery employed. The year is divided into three terms.

The following is the schedule of studies:-

Sericulture Course - First Year. - Per week lessons are held in practical ethics for 1 hour, Mathematics 3 hours, English 6 hours, German or French 2 hours, Zoology 4 hours, Botany 3 hours, Physics and Meteorology 3 hours, Chemistry 3 hours, outlines of sericulture 2 hours, Education of Silk-worms 2 hours, Gymnastics 2 hours, Zoological and Entomological Practical Work 3 hours, Botanical and Plant Pathological work 3 hours, Chemical Laboratory 3 hours, and ~~Fram~~ farm Practice 2 hours

2 hours (the last one only in the first and second terms.) This makes 40 hours work per week.

Second Year Course. - Per week classes are held in Practical Ethics for 1 hour, English 5 hours, Entomology 3 hours, Physics and Meteorology 2 hours, Soils and Manures 3 hours, Education of Silk-worm 2 hours; Anatomy and Physiology of silk-worms 2 hours, Microbiology 1 hour, Pathology of silk-worms 3 hours, Filature 2 hours; Gymnastics 2 hours, Zoological and Entomological Laboratory 3 hours, Farm Practice 3 hours, Silk-worm Anatomy (Practical) 3 hours, Practical work in silk-worm diseases 3 hours. In addition to this, in the First Term silk-worm rearing is for 14 weeks and grainage work for 3 weeks. This makes 41 hours work per week. In the Second Term there is practical rearing work for 3 weeks, as also grainage work for a similar period.

Third Year Course. - Per week classes are held in Ethics (Practical) for 1 hour, Plant Pathology 2 hours, Outlines of Agriculture 2 hours, Laws and Economics 4 hours, Agri-Sericultural Economics and Politics 4 hours, Bio-Chemistry 3 hours, Mulberry cultivation 3 hours, Genetics 3 hours, Anatomy and Physiology of silk-worm 2 hours, Pedagogics 1 hour, Gymnastics 2 hours, Practical work in Anatomy 3 hours, Practical work in Silk-worm Pathology 3 hours. In addition to this there is Practical Work in rearing for 14 weeks in the First Term and 3 weeks work in each term in Grainage. Altogether, 42 hours work in Filature should be done ~~in Filature~~. There is 33 hours work in a week. Besides, students in 2nd and 3rd years should select some subject and do research work.

In Filature and Moriculture course, subjects relating to these branches are given more prominence.

In addition to the above courses there are subsidiary courses in Sericulture for one year for practical men and in Filature for girls. From time to time there are abbreviated courses in Sericulture and Filature.

The

The Strength of the College in Tokyo in 1929 stood at :-

No.	Course.	1st Year.	2nd Year.	3rd Year.	Total Number.
1.	Sericulture.	30.	30.	34.	94.
2.	Moriculture.	20.	20.	17.	57.
3.	Filature.	30.	30.	27.	87.
4.	Practical.	40.	-	-	40.
5.	Girls (Filature.)	40.	40.	-	80.
	T o t a l.	160.	120.	78.	358.

The number of students in Uyeda and Kyoto Colleges is about 15 % less than that in Tokyo College.

The students of Sericulture and Moriculture courses after graduation are generally attached to one of the Professors as apprentices for one year, and then sent out to Experimental Stations as assistants, where they remain as apprentices for one year. In any case they will not be given any independent work till they have had full opportunities of working satisfactorily in the several branches. These assistants subsequently rise to the ranks of Assistant Experts and Experts and the more fortunate ones to be Directors of Experimental Stations. A few filature graduates are sent out to Government filatures, and most of them are absorbed by private filatures as assistant experts, supervisors, etc. Finally, they may be put in charge of filatures. Graduates of practical course may become assistants in Experimental Stations, finally, Assistant Experts, and in rare cases Experts. Most of them do their own work as rearers or seed makers. Girl graduates may be absorbed by Government Filatures, and most of them go out to private filatures as supervisors or teachers. The College Graduates go out as teachers in Prefectural Sericultural Schools too. Formosa and Korean Sericultural Departments absorb quite an appreciable number. The South Manchuria Railway Company appoints a few.

The Colleges inculcate a spirit of scientific investigation and research which pervades all sericultural work in

Japan

Japan. This is one of the important reasons why organization is not only effective, but progressive.

Staff of the Colleges. - There is a Director, and 16 to 17 Professors for subjects already enumerated in the Courses of Colleges. Most of them have had the benefit of research work in foreign countries. In addition to Professors, there are Assistant Professors for several branches and each branch has several assistants. Besides, there are Lecturers also according to requirements of any particular subject.

E q u i p m e n t. - All the Colleges have suitable and necessary buildings for Offices, Reception Rooms, Meeting Hall and Laboratories for Chemistry, Anatomy, Bacteriology, Pathology, Rearing Houses (at least three buildings, each having 8 rooms of the capacity of 10' x 12', with an underground leaf store of 30' x 40' x 8',) Moriculture Laboratory, Filature, and a mulberry garden of not less than 12-15 acres. All the Laboratories are well provided with necessary electrical, mechanical and other appurtenances for work of students, as well as for research work of Professors who are expected to and who do really valuable research work. Full opportunities are afforded to students in practical work. There is a well furnished general library attached to each College. Besides, each Department has its own library for routine and research work. In addition to books in Japanese a fairly large number of books is made available in French, German, Italian, and English. Uyeda College has a Silk-waste Spinning and artificial silk manufacturing plant. It has a splendid chemical laboratory. Kyoto College specialises in electrical apparatus for hatching silk-worm eggs.

The Colleges have one dormitory each for boy students, and one for girls.

The Imperial University in Kyushu and the Agricultural University in Tokyo teach sericulture also. The Agricultural University in Tokyo provides professors to the Sericultural College as also Experts to Imperial Experimental Stations.

Prefectural

Prefectural Sericultural Schools. -

These schools are of the standard of Middle Schools. These institutions admit graduates of higher or lower primary schools. Courses are generally for three years. But, in a few cases five years' course may also exist. The five years' course is intended for graduates of lower primary school, while the three years' course admits graduates of higher primary school.

The subjects taught are - Japanese Language, Ideographs, Arithmetic, Algebra, Calculation by Japanese Counter, Botany, Zoology, Physiology, Geology, Mineralogy, Physics, Meteorology, Physical and Chemical Experiments, Japanese History and Geography, Foreign Geography, Oriental History, European and American History, Agriculture, English, Agricultural Economics, Book-Keeping, Rearing of Silk-worms, Anatomy, Physiology and Pathology of silk-worms, Reeling, Utilisation of silk waste, Mulberry Cultivation, Horticulture. Suitable arrangements exist for practical work in all sericultural subjects. Besides these schools maintain good museums. Generally a small, but, decent filature is fitted up. Some schools like that of Okaya School in Nagano Prefecture have splendid filatures with up-to-date silk testing machinery. Some of the schools have already abandoned the Japanese wooden houses, and have constructed ferro-concrete buildings.

Out of forty-seven Prefectures, sixteen Prefectures maintain Sericultural Schools. Where no Sericultural Schools exist, the Agricultural Schools serve the purpose as they teach sericultural subjects. There are altogether 225 Agricultural Schools, where Sericultural subjects form part of curricula. In addition to this, Sericultural Schools are founded by private organizations or gentlemen. Some of these schools are as good as any of the Sericultural Prefectural Schools. But mostly their standard is lower than that of the Government Institutions. The Prefectural Experimental Stations provide educational facilities.

The

The graduates from Prefectural Sericultural Schools mostly go back home and do their own work, either rearing or seed-making. A typical school which sent out 537 graduates, states that 67 % of these graduates set up their own work, 8 % went up for higher qualifications; 7 % took to Government Service, 7 % to teaching profession, 6 % took up to business, and 3 % were dead. The teachers and experts employed in Guilds are mostly graduates of Prefectural Sericultural Schools, or graduates from Experimental Stations. These teachers and Experts keep a living contact on the one hand with the general sericulturist, and on the other with institutions and consulting bodies.

Thus, Sericultural Education in Japan is not only extensive, but, also specialised. It affords full opportunities to all class of teachers, experts, and research workers. The benefits ~~occuring~~ accruing from graduates of Sericultural Schools, as also from those of Agricultural Schools settling in life as farmers and sericulturists is immense. These practical workers carry the scientific and practical training with them and develop work in their own spheres, either as rearers or seed-makers.

SERICULTURAL CO-OPERATION.

The guild system in Japan in all branches of all industries exists on an extensive scale, and is specialised. There are two kinds of guilds, viz., ordinary guilds and guilds coming under the category of "Same Profession Industrial Products." In the ordinary guild, membership is voluntary. In the latter case, ~~membership is compulsory to all of the same profession~~ Such a guild can be started when 2/3 of the members of the same profession wish to ~~when 2/3 members of a locality~~ organize themselves into a guild. Consent of members ~~ship becomes Compulsory~~. The following is a brief description of the various kinds of guilds in existence. -

(1) Silk-worm rearers' Village Guild:- Generally there is one guild in each village. But, in big villages there may be two or more guilds. In this case, all unite into one league. The objects of these guilds are - (a) to select and standardize varieties

varieties of silk-worms for their respective areas, (b) to buy silk-worm eggs and other things co-operatively, (c) to rear 'Chawki' together, (d) to employ experts to improve the technical side of the industry, (e) to have model plantations, (f) to extend and improve mulberry farms and to have special farms for autumn and summer, (g) to prevent diseases of mulberry, (h) wherever possible to have cocoon markets, (i) to sell cocoons jointly, (j) to hold competitions and exhibitions, (k) to have sericultural instruments, etc., for use of members, (l) to accumulate reserve funds, (m) to have Co-operative Savings, (n) to render monetory assistance, (o) to collect and keep accurate statistics, (p) to co-operate with experimental stations in popularising encouragement breeds of silk-worms and of mulberry, (q) to arrange for lectures and demonstrations, (r) to bring to the notice of Government such matters as are necessary for development of the industry from time to time, (s) to respond to enquiries, etc. of Government Institutions.

It may be said that almost all sericultural villages in Japan have Guilds. The total membership is 25 % of all the rearers of Japan. In the course of a generation or more it is intended to bring all the rearers within the influence of the Guilds. This Guild belongs to the ordinary type, or in ~~Guild~~ unusual case to the other type.

(2) County League of Rearers' Guild. - All the rearers' guilds in a County are affiliated to the County League of Guilds. The objects of this League are to establish relationship between its constituents & to communicate with other sericultural bodies. This League is generally situated in the Control Station or in the County Administration Office. It is financed by the component guilds proportionately to the membership of each guild, etc.

(3) Prefectural League of Rearers' Guild. - This League is composed of all the County Leagues of Rearers' Guilds. The objects of this League are to improve sericultural industry by co-ordinating the activities of its constituent guilds,

and

and by establishing friendship with similar bodies. It investigates measures relative to the improvement of the industry, guides its component guilds and helps them, furnishes information to Government enquiries, places before Government measures calculated to improve the industry. It distributes the subsidies given by Government to the various guilds. It is financed by its component bodies proportionately, and it receives subsidies from Government and contributions from other sources. It takes measures to open new guilds.

(4) Prefectural Guild of Silk-worm Seed-Makers. - Every Prefecture has a guild for all the seed-makers in the Prefecture. This guild belongs to "Same Profession Important Products" Association. It may have a branch each in a County, when found necessary. All the guilds of the seed-makers are members of the Raw Silk Association of Japan. The aim of this Guild is to remedy existing defects in the work of seed-makers, to promote profits and to develop work. Its work is to study sericultural industry, improve existing matters, to improve the existing breeds of silk-worms, to arrange for lectures and training coursen, to suggest to Government measures calculated to improve the industry, to reward employees who work for long periods, to fix maxima and minima of prices of egg cards, and any other matters that concern the industry. Members should carry out microscopic examination of eggs, worms and moths, and they are required to reject the lot of worms which is pebrinised, forced emergence of moths should be carried out for preliminary examination and when more than 3 % of pebrine is found, that lot should be rejected. Disobedience of rules and bye-laws of the guild is severely punished by heavy fines. This guild is a very important guild that practically gives effect to the important principles in the manufacture of good seed of improved varieties of silk-worms, takes all necessary precautions against pebrine disease, and gaurantees in an implied way excellent seed. It also creates good understanding among its members by stopping unhealthy competition.

Prefectural

(5) Prefectural Guild of Mulberry Nursery Owners:- This guild may be of any one of the two types, viz., Guild of the "Same Profession Important Products" or ordinary guild. Government recently have been laying emphasis on the formation of the first type, as it is considered that good mulberry nurseries are essential for a sound basis of the industry. Each County may have branch of its own. Growers and sellers of mulberry saplings and grafts are members. These members are generally very poor. Without an organization of this type it would be impossible to effect improvements in moriculture. The restrictions and obligations imposed in this guild are very stringent, to enable rapid improvement of mulberry "Stocks." The work of this guild is to investigate quality of mulberry, investigation of species and varieties, popularisation of "Encouragement" varieties, increase of sales of mulberry stocks, establishment of model mulberry gardens, improvement in methods of packing and transport of mulberry stocks, protection against diseases and pests, arbitration of differences among its members, inspection of mulberry grafts and plants for 'Passable' and 'Impassable ones. The last named is the most important practical work done by the guild. Standards are fixed for passable grafts, and those below standards are impassable. Only passable grafts and plants are allowed to be sold. The Inspector of the Society inspects each plant of the nursery owner. The guild is financed by the members.

(6) Silk-worm Seed and Cocoon Brokers' Guild. - This guild is of the ordinary type. Its members are seed or cocoon brokers or of both residing in the Prefecture. The object of this guild is to eradicate evil practices existing in the trade. A license is necessary from the Governor for starting broker's business in seed or in cocoons. This is a Prefectural Guild.

(7) Silk-worm Seed Dealers' Guild. - This guild comes under the type of "Same Profession Important Products Guild. Generally there is one for each prefecture. Counties may have branches

branches. It aims at removal of defects and improvement of the industry. Its work consists of research into quality of seed, distribution of seed of good quality, acting as intermediary between co-operative buyers and sellers of seed. It arranges for lectures, training courses, research into management methods, sends investigators in search of good seed, finds out places where seed could be sold, co-operates with other bodies.

(8) Cocoon, Silk, Brokers' Guild. - This may be either of the ordinary type or of the type of "Same Profession Important Products Guild." Its aim is to improve the work of members. Its work consists in seeing that spring, summer and autumn cocoons are not mixed, that different kinds of silk are not mixed in one and the same lot, thick and thin, good and bad, good and bad cocoons are not mixed in reeling, to prevent chrysalides being added to waste in business, not to allow any other material to be added to silk-waste to increase weight. Members are those engaged in raw silk trade or agents, those engaged in manufacture of inferior grade of silk from low grade of cocoons, and dealers in such silk, those engaged in inferior cocoon trade, etc. The member has a badge of the guild as a mark of his membership.

(9) Filature Guild. - This is of the type of "Same Profession Important Products," and there is only one for a prefecture. All filatures of the prefecture are members. Fees is collected proportionately to the number of basins each filature has. This guild is a member of the Raw Silk Association of Japan. It executes all important decisions of the Raw Silk Association of Japan, such curtailment of production, or increased production of raw silk, or enhancement of wages, etc. to workers and in fact all matters decided upon by the Raw Silk Association of Japan. It aims at mutual friendship, removal of defects in the reeling industry, to improve financial and other resources, to unify cocoon quality, to carry on research work in reeling, to train workers, to protect them, to hold competitions, to honour them, to bring to notice of Government important matters regarding the industry, to furnish information to Government.

to Government. This is a very important Guild. It is desirable to have a guild of this nature in Mysore at least for the "Domestic Unit" owners so as to bring them closer with a view to find out suitable markets and to act in co-operation. ~~in Mysore.~~

(10) Cocoon Drying Guilds. - With a view to increase and improve trade in conditioned cocoons, Government have been encouraging formation of these guilds in all prefectures. Each prefecture has one union of such Guilds which exist one in each County. Some of the prefectures have gone ahead and already established the full number of such guilds in their jurisdiction. Others are following suite. Government contribute 4/10 of the costs ~~for~~ of installation of cocoon drying machinery and cocoon store houses which are ferro-concrete, rat ~~proof~~, fire ~~proof~~, and moisture proof buildings. On an average Government have been contributing about Y. 30,000 (i.e., ₨ 45,000/-) per guild. Membership of these guilds is open to all sericulturists or to persons of independent means.

In Mysore such a guild or organization to introduce cocoon drying and conditioning and trade in 'Conditioned Cocoons' is necessary for obvious reasons.

A separate regulation has been passed recently in Japan on the subject.

(11) Guild for Improving Cocoon Spinning. - The Filature Guild generally finances this guild. The work of this is to improve spinning of cocoons.

Co-operative filatures will be dealt with in reeling. There is an Association of experts of various guilds. It aims at improvement of sericulture and research into various subjects connected with the industry.

All phases of sericultural industry are well represented in co-operation. This has considerably facilitated spread of knowledge in all branches. Researches and other benefits reach these bodies easily and spread out, matters of importance are well discussed and measures adopted. The guilds have

have, in fact, been institutions responsible for a good deal of improvement in sericultural activities.

RAW SILK ASSOCIATION OF JAPAN.

This Association came into existence in 1914, and is organised under the Law of Important Products Same Profession. Membership is open to guilds and not to individuals. Its members are Filature, Seed-makers', Silk and Cocoon Brokers' Guilds, i.e., Guilds which come under the denomination of "Guilds of Important Products Same Profession." Some rearers' Societies that come under the above are also members. Its total membership is 130. Each Guild elects its representative as its mouthpiece. The component guilds subscribe on a graduated scale. 30 % of the total expenditure is charged to all the component guilds equally, 55 % is charged to Filature Guilds, and 15 % is charged to Seed-makers' Guild. The payment by a Seed-makers' Guild is in direct proportion to the quantity of seed produced. The aim of this Association is to promote mutual friendly relations among its members, to enlarge exports of raw silk, and to increase profits of sericulture. Its work is removal of defects in the industry, to find out methods for improvement of sericulture, suggesting new law and Regulations concerning Sericulture, to Government (including subsidies and subventions), attending to all queries from Government, keeping friendly relations with similar bodies in foreign countries, guiding its component guilds in work, to arbitrate in matters of dispute, to take all such steps that are calculated to improve the sericultural industry of Japan.

This Association has a President (generally a Prince of the Royal blood), and three Vice-Presidents, Committee Members 30, Secretary 1, Manager 1, Assistant Manager 1. Except the President all are elected. One of the Vice-Presidents is in charge of all the work in the Office. Some of the above officers may be paid. Apart from representative and executive committee members, the Association has consulting members who are elected from among the exporters

exporters of raw silk and filatures, etc. The Association has a capital fund of Y. 500,000. The President is authorised to spend Y. 20,000 annually, but, the amount has to be re-imbursed before the end of the financial year. This Association has no branches. Its work in the prefectures is carried out by the component guilds. The Association sends out delegations to foreign countries for investigation study, and to improve trade relations. It is a very influential organization and its decisions are mostly upheld by Government and acted upon. The recent grant of a subvention of Y. 3,000,000 to subsidizes filatures to meet the losses due to heavy fall in prices was due to the recommendations of this Association.

SERICULTURAL ASSOCIATION OF JAPAN.

The jurisdiction of this Association is all Japan and was established in 1893. Membership is open to all individuals engaged in any one of the branches of sericulture. Members are of three kinds - Viz., (1) Honorary Members - They are elected from among the Imperial House-hold. (2) Special Members - Those that contribute Y. 50.00 at one time, or benefactors of the Association, or men of particular experience, (3) Ordinary Members - Those that contribute Y. 3.00 at a time. No member has to pay any recurring annual subscription. There are now, 1 Honorary member, 10,452 Special Members, and 257,372 Ordinary Members, bringing the total to 267,824 members.

Officers. - 1 Honorary President, one President, 2 Vice-Presidents, two Superintendents. These are elected by the Trustees (25 in number), who are themselves elected in a general meeting.

Branches. - There are 44 branches in 44 prefectures. The Branch President is the prefectural Governor.

The work of the Association is-divided into five branches, viz., (1) Association work, correspondence, employment matters, (2) Financial, (3) Department of Periodicals and Memoirs, (4) Investigation Department, (5) Expansion Department

Department, which holds lectures, Cinema Film Shows re' sericulture, arranges exhibitions and competitions, etc.

Periodicals. - The Association publishes two periodicals, one a monthly, containing literature, etc. on sericulture, the other "Light of Sericulture", containing literature regarding practical matters. The latter is published in 23 branch associations also. The branch associations under the Governor have a Clerk or two to do the work of the Association. Generally, this clerk works under the directions of the Sericultural Officer.

The work of the Association consists of, - Researches into sericulture, spreading sales of Japanese silk in the world, co-operation with other bodies, honouring of benefactors of Sericulture, holding of competitions, lectures, shows, etc., improving co-operation in the industry, publication of periodicals etc., other matters relating to the improvement of sericulture.

The Society has three committees co-opted with it, viz., Technical Committee, Correspondence Committee, Encouragement and Subsidy Committee.

There is a general meeting every spring. It has its estates and securities to the extent of over half a million. Its expenditure is met from the interest on its securities and estates which are the result of several subscriptions as already stated. There is an imperial donation which is kept as a separate fund. The work of the branch societies is to raise new members, to have a directory of members together with their domiciles, etc., to spread out society's publications, getting contributions, etc., assisting and guiding bodies engaged in sericultural work, researches and statistics, opening of competitions and exhibitions. The Central Association may give subsidies to branches which do good work. A branch society may have experts for various works.

The Association may receive subsidies from Government and distribute to rearers' Guilds according to merit or special circumstance.

The Mysore Silk Association has necessarily to combine in itself

itself the function of Raw Silk Association as well as of Sericultural Association.

MULBERRY AND ITS CULTIVATION.

There are 24 species and 1 variety of mulberry. Geographically it has four groups:-(1) China, Chosen (Korea), Manchuria, Japan, Malaya, and Northern India, (2) Central Asia, (3) Western Africa, and (4) America. Its distribution lies between 50° North Latitude to 10° South Latitude. Regionally it is tropical to sub-tropical.

Japan has over five hundred varieties. Of the five hundred varieties only 22 are considered to be very good in Japan. These varieties are called "Encouragement varieties", i.e., varieties which Government encourage farmers to plant in preference to other varieties, and have been selected with special reference to local climatic conditions, economic and other advantages. All these varieties are not "Encouragement varieties" all over Japan. A few are advised for each prefecture. Some of them are universal.

Besides the above a few more newly evolved varieties in the Imperial Station are coming into vogue. Some of these varieties are suitable for branch-feeding of silkworms which is coming into vogue, and in some districts it is already the prevalent method in spring season. Some varieties are early and some are late, some are suited to rocky soil and some are cold resisting, and some draught resisting in Japan. The most important work done in respect of mulberry from an industrial point of view is to have selected advantageous varieties.

P R O P O G A T I O N.

There are four methods, viz., seedling planting, graft planting, layering, and cutting. Cutting planting which is the universal method in Mysore is almost out of vogue in Japan, as plants got out of this system are poor in several respects.

L A Y E R I N G.

This system is yet common in Japan. There are various methods

methods of layering. Chiba system in which branches are bent at an acute angle is fruitful of good results as it gives good plants.

G R A F T I N G.

This is the more modern and fruitful method. Roso, is generally employed for 'Stock.'

S E E D L I N G S.

These are raised mostly for grafting work. Out of a total of about one billion mulberry plants produced annually 80 % are grafts, and the remaining are from layering and other methods.

Mysore has too long been following the "Cutting Planting" method which is the worst that could be thought of. This method should be displaced by seedling planting, and subsequently by grafts when sufficient work has been done on finding out suitable grafts for Mysore. Grafts are suited for warmer regions. It is even so in Japan.

(N.B. - The enormous quantity of grafts, etc. is produced in Japan by about 30,000 mulberry owners, each producing on an average about 20,000 to 40,000 plants. Very rigorous tests are conducted before grafts or seedlings are allowed to be sold out. Each plant is examined for its general health, injuries, height, and thickness. If all tests are satisfied, the planter is allowed to sell them after attaching the necessary certificates. This examination is conducted by an Expert of the "Mulberry Nursery Guild." The guild determines the various tests according to standards prescribed by the Experimental Station. The Moriculture Expert of the district is always on advisory board. Those that violate rules and regulations of the Guild are fined heavily. Of late, much vigilant supervision is exercised over this branch of the industry recognising the great importance the mulberry cultivation has.)

METHODS OF GRAFTING.

The methods adopted are "Scion Grafting", root grafting, bud grafting, etc. The commonest method is Scion grafting.

In

In Mysore all methods have to be tried before adopting any particular method as there is considerable difference in climatic conditions between here and Japan.

SYSTEMS OF CULTIVATION.

All the three systems, viz., Tree, Middle, and Bush are in existence. Tree system is adopted in colder regions, such as - North and North-Western Districts. Middle System is common in hilly regions. Bush is the commonest, and forms about 85 % of the total area under mulberry. In warm regions it is advantageous to have "Bush" cultivation. Trees are prone to pests. Tree leaves are superior in quality. The 'Tope' system of Mysore has undoubtedly a great economic and climatic advantage.

F A R M S.

There are gardens for spring crop only. Gardens for spring and autumn crops only, and gardens for spring and autumn, and gardens for spring and summer only. There may be gardens for chawki and mature worms separately. In the South, usually Spring and Autumn, or Spring and Summer gardens only are cultivated. In the North, the system differs. What is necessary and important is to see that too many crops are not harvested, as that affects the vitality of the plant, and is also a false economy. In Mysore it is necessary, at least in irrigated gardens, to standardise the number of crops to be harvested. Actual experiments have to be conducted before definite scheme could be given.

ROTATIONAL METHOD.

This method is practised in certain areas. Mulberry is cultivated for 10-15 years, uprooted, vegetables followed by wheat are planted, and again mulberry is planted fresh. An improvement over this method is that after uprooting mulberry in spring, paddy is cultivated and harvested in autumn, wheat is planted. This rotation takes place for three years. Mulberry is again planted. This method is

recommended

recommended for up-keep of soil fertility and to safeguard against deterioration of mulberry.

INTERCULTIVATION.

Mulberry is intercultivated with vegetables in the vicinity of cities. With high forms of training just as the 'Tope' System in Mysore it yields double results.

PLANTING METHODS.

Planting is generally done in spring season. For the plant physiologically, planting would be better in autumn season. Usually, in 'Bush' system, plants are 2' x 5'. The rows are always north and south. Closer plantation is not done, as it is inconvenient of management, open to attacks of diseases, and leaves ripen early. Besides, the yield of leaf is in no way more, the quality of leaf is undoubtedly inferior. On an average, per two crops per acre, when the number of plants is 1,500, 3,500, and 9,000, the respective yield is 6,000, 6,000, and 6,500 lbs. It is necessary to conduct experiments on this subject to demonstrate to raiyats to abanden close planting as is usually done in irrigated gardens in Mysore.

While planting cuttings it is desirable to have 'Vertical' planting, and not slanting planting as is done in Mysore.

TRAINING OF MULBERRY PLANTS.

One is the Tree System and the other is pruning system. The former is adopted in Northern regions which are cold and where rearing is not intensive. It is open to attacks of insects and pests. Its leaf is of superior quality. Some seed-makers use this method. The latter has many modes, viz., Hand and No-hand Systems. In each there are four methods, viz., bottom pruning, middle pruning, High System, and Chinese Type. Bottom pruning is adopted in regions where there is no snow. Pruning is a systematic work and not a reckless operation. Great care is bestowed while pruning. The very instruments here will have to be

changed

changed. This subject is of great practical importance and a number of experiments have to be conducted to select the most suitable ones for our 'Bush' and 'Topes." The 'Akita System' which is suited to warm regions may be adopted here. Some old trees of this system produce as large a quantity as 5,000 lbs. per two crops. The average is about 1,000 lbs. per year. The Nagura method gives very large quantity of leaf in which a large number of branches is trained against a small number of branches in the 'Akita System.' The quality of leaf is very poor.

QUANTITY OF LEAF PER ACRE. (for two crops per year)

This varies according to region. In the Northern part it is about 4,500 lbs. per acre, in the central regions about 6,500 lbs., in western districts it is 7,000 lbs., in the south it goes up to 12,000 lbs. According to variety it may range from 10,000 lbs. in Hikoujiro to 16,000 lbs. in Kasuga.

CULTIVATION.

In the beginning of spring, farm is dug and levelled; in the beginning of summer the 'Hands' are covered, and sloping furrows are made between the rows of plants. In autumn, soil is again levelled, and in winter 'Hands' are exposed to the cold. Plough is very rarely used. A shovel pick-axe with a long lever is worked by hands and feet. This is an inconvenient instrument for our workers.

MANURES USED.

Manures used depend upon the soil and the number of crops to be harvested. As a rule mixed or rotational system is adopted. The farms are well manured. Usually manure costs up to 20 % of the total expenditure on garden. In a typical volcanic region this rotation is followed.

Winter Manuring. - 2 tons of compost per acre, contains 20 lbs. of N_2O, 10 lbs. of P_2O_5, 15 lbs. of K_2O.

SPring

Spring Manuring	(300 lbs. of human excreta contains - 8 lbs. of N2 O, 1¼ lb. of P2 O5, 10 lbs. of K2 O. Plus 225 lbs. of Soya Bean Cake contains - 15 lbs. of N2 O, 2 lbs. of P2 O5, 1.5 lbs. of K2 O.
Summer Manuring.	(1,600 lbs. of Human Excreta, contains -70 lbs. of N2 O.
Totals, contains	115 lbs. of N2 O, 57 lbs. of P2 O5, 100 lbs. of K2 O.

For alluvial soils, the following ~~is xxxxxpt~~ recipe is one of the many used. - 2 tons of compost, 9/10 ton of human excreta, 4 Cwts. of Soya Bean Cake, and 2 Cwts. of Superphosphate of Calcium. In mountainous regions, one of the recipe used is ¾ ton Human Excreta, 3/30 ton of calcium oxide, 9/80 of a ton of Soya Bean Cake, 180 lbs. of Superphosphate, 1½ tons of silk-worm litter per acre per annum. In a sandy soil one of the recipes used is - Compost 2 tons, Soya Bean Cake 1¼ ton, Superphosphate 40 lbs., Human Excreta ½ ton, Green Manure 1 ton.

Experiments in favour of mixed and rotational systems have to be conducted. It will not be practicable to prescribe one general formula for all regions and for all kinds of systems of cultivation in Mysore, viz., for Khushki and for Bagayat.

Use of fertilisers on a large scale is not yet common in Japan.

MODE OF PICKING OF LEAVES.

Great care is bestowed while picking leaves. The axilary buds are allowed to remain in tact. Single leaf picking is adopted, for picking leaves in chawky stages. A finger nail of a particular make is used with great advantage for picking leaves on a large scale. This method may, with advantage be adopted here. For 'Branch Feeding' of worms, branches are cut entirely and subsequently the garden is given a 'Dress cutting' to remove the defects caused therein.

PRESERVATION OF LEAVES.

Great care is taken in storing leaves. Badly stored leaves, means indication of "Flacherie" in the worms. Generally Government Institutions and some seed-makers have an underground

underground cellar attached to one of the 'rearing' buildings. This cellar is about 15' x 10' x 9' in concrete and cement. Leaves can be preserved even for two or three days without deterioration in quality. The construction of such cellars in a hot country is even more imperative. Even the ordinary rearer takes great care in preserving leaves.

HYBRIDIZATION.

This work is difficult with mulberry, due to difference in time, in appearance of male and female flowers. Pollen lives for 60 days and can be preserved for 16 days without loss of vitality, but stigma dies soon, and often the female flower blossoms earlier. When female flower blossoms later than the male, cross-fertilisation could be effected. Before doing any cross-fertilisation work in Mysore with Japanese varieties, it would be necessary to study the varietal characters and behaviour of each in several respects. This work is not only important, but also absolutely necessary. More land would be necessary for this work in our gardens.

FARMERS' GARDENS.

It is very rarely that a raiyat in Japan, plants cuttings. He uses grafts or layers. Plantations are not close, pays great regard to up-keep of soil fertility by using suitable quantities and varieties of manures, harvests less number of crops, allows the plants to develop well between crop to crop, prunes the garden with great care, which is absolutely lacking in Mysore on the assumption that mulberry stands any bad treatment.

Diseases.

The list of diseases of mulberry in Japan is long. Some of these are trunk, some leaf, etc. diseases. Remedial measures are few, and where they exist they are uneconomic. Against "Brown Spots" on trunk, there is a preventive measure, viz., application of coaltar and soap solution. For the bacterial disease of leaves no remedial measure has yet been found out. Mumia disease is very

common

common. Professor Miyake's treatment is by use of Chloro-picrine in the soil. The results are very good. The cost of treatment is fairly prohibitive to a raiyat. For root-rot no remedial measure has yet been found out. The cause of dwarf disease has not been fully understood. It is due to physiological disturbances, resulting from cutting off shoots too often. There is absolutely no remedial measure against it. Prevention consists in not cutting the plant too often. Frost injury is common in Japan. Mysore, need have no fear at any time. Septogloem Meri, which is seen in Mysore also is common in Japan. No economical remedial measure has yet been found out. Mildew is not so common in Japan. Satisfactory remedial measures have not yet been found out.

REARING OF SILK-WORMS.

In rearing the most important requirement is a suitable rearing house. In Japan rearing houses are standardised in all Government Institutions. They generally run north and south and are ordinary Japanese style buildings, which are as a rule built of thin mud walls; outside being covered with wooden planks. The length of the house is between 60' to 80'. The whole building is divided into 5 to 7 rooms of uniform dimensions. The rooms are separated by a thin wall and have wooden plank ceiling and there is a tiled roofing above it. The second story is used for stocking materials and also for use during mountings. All the rooms on either side have sliding doors in wood and paper for the full width of rooms. Lengthwise on either side of the building there is a verandah of about 4' width, provided with half glass and half wooden sliding doors, so that when the sliding doors of the verandah and the sliding doors of rooms are opened the whole building (first floor) becomes a completely open house. There is a pit 3' x 2' x 2' made of plaster in cement provided with a plank shutter and side chimney for draft. During spring season fire can be put into it and the room kept at the required temperature of about 80° F. Each room has one or two draft chimneys from the plank ceiling up into the air. The top of this draft chimney has a revolving fan which moves on a pivot-socket arrangement and responds to motion of air. This chimney can be shut by means of a shutter

shutter when not required. Due to the revolving fan on the top of the chimney air inside the room is drawn out. Thus, all vitiated air is driven out, and the room is kept in a hygienic condition. This arrangement is simple and deserves to be introduced in Mysore.

In summer season a reed "pent" is put up on either side to keep the rearing rooms quite cool. The arrangement though simple provides for hygienic conditions necessary for rearing of silk-worms. This type of rearing houses ~~have~~ has with great advantage been adopted in Central Chinese Institutions and also in the South with great success. This type of rooms can with advantage be built here. ~~One of~~ The rearing houses has always an underground cellar for storing of leaves and one wing is extended to admit of holding office for the staff.

Some Institutions have special rearing houses for physiological, bacteriological, and genetical work. Such houses are humidity and temperature controlled by means of temperature and humidity ~~and~~ controlling apparatus. Generally ammonium plants are used for regulation of temperature. The general plan of the house is the same as in the first case, but the buildings are in "Ferro-Concrete." Ordinarily a building with all machinery necessary for control of humidity and temperature may cost about Y.60,000.00 Provision is generally made in such cases for having a cold storage for "Hibernation" of silk-worm eggs and keeping mulberry cuttings. This feature is a growing one in the institutions in Japan. Especially, Genetical work has no real scientific value, as in quantitative characters, without the control of environment. No one can definitely ~~found~~ find and explain the causes that operate, since so many characters ~~to be had for~~ in genetical work in sericulture are quantitative. The imperative need for having temperature and humidity controlled chambers has been practically recognised, and more additions are annually being made in all prefectures.

The

The raiyats' rearing houses in Japan are simple, Japanese styled houses where they live. The rooms have card board sliding partitions, and this enables them to increase the dimensions of the rearing houses whenever necessary. For heating in Spring season ordinary braziers are used. Ventilation is easily adjusted by means of the sliding doors, and by installing roof revolving draft chimneys. In a word, full regard is had to all hygienic conditions in the rearing houses.

The seed-makers' rearing houses are of the ordinary above type. But, many of them prefer to have rearings in the second story of the building especially during summer. For controlling humidity some seed-makers now a days freely employ adosol (Volcanic earth) which is hygroscopic. Rearing houses are supplied with air that is forced through an adosol supply by means of a fan worked electrically. For regulating temperature ordinary braziers are used. Some Joint Stock Companies which are filature owners like Gunze, Katakura, etc., produce seed on a large scale. Such companies generally have rearing houses of the type usually had in Government Institutions.

APPLIANCES.

Generally a stand is of about 7' in length and 2½' in width, and about 8' to 9' in height. It is made of ordinary wood with removable bamboo cross bars. The distance between tiers is about 9" to 11". On the whole the stands are simple, cheap, with proper space between tiers, and are handy, and convenient in handling trays. Sometimes, special kinds of stands are devised for special work.

T r a y s. - These are made of bamboo, are rectangular in shape and very convenient to handle. The ridge is either full bamboo or half "Splits", the ground is of thick 'Splits' woven into lattice of a special design, ridge is entirely wanting in. In size they are 3' x 2½'. For chawki rearing, box system is coming into vogue. These are of either zinc or card board and may be 20" x 10", and covered with a lid. This arrangement does well for a chawki rearing. Bidadi rearers are in the habit

of

of confining chawki to brass plates and cover it air tight. This method may be modified into the more scientific one as in Japan.

N e t s. - These are very freely used all over Japan, as it facilitates cleaning work, and is very hygienic as against hand cleaning and transfer of worms. In the tray a mat woven of reeds is employed over which generally paper is spread. Worms are fed on this, and before cleaning net of suitable size is spread over, and worms are fed twice or so, and the whole net with worms is transferred to another tray. Thus, one net is practically left in the tray. Nets are of square mesh which, of course, vary according to the age of the worms. These are made of fibre, and two opposite sides are held in ~~thin~~ split bamboo. For advanced age worms nets are made of paddy straw. The use of nets can be adopted in Mysore with advantage. Manufacture of nets can be started in the houses of sericulturists as a subsidiary occupation.

Stands for changing beds and for feeding. - Small X type collapsible stands are used for the above purpose. Their use in feeding enables feeding to be done standing, and allows it to be done more hygienically than in ordinary way. These will also have to be used here.

M o u n t a g e s. - Various methods are adopted for mounting of worms. The best are V type collapsible ones. These occupy very little space when not in use. Worms can find suitable places in the Vs for spinning. There is perfect ventilation, and good cocoons are spun by worms. These can be spread in the ordinary trays when worms are to be mounted. Ordinary twigs are also employed in some places. Another kind of mountage in use is made of paddy straw which is taken into thin bundles of ten to fifteen straws, and bent into contiguous Vs, which are arranged into parallels on the bed of a tray. The cocoons spun are good,

but

but since they cannot be re-employed, and involves labour for each crop their use is becoming less. But, where labour and paddy straw are to be had cheap these serve the purpose well. Centipede mountages are also in use.

Knives and Chopping Boards. - ~~These~~ Knives are of steel, and are thin and broad. The sizes vary according to the size of leaf to be cut, etc. What is important is that the knives should cut 'True', and should not 'Express' juice out of leaves. Mechanical arrangements for cutting leaves are going out of use as 'Branch feeding' is coming more and more into prominence. Boards are square, very thick and of fairly hard wood.

Dry and Wet Bulb Thermometers. - The use of these instruments is very common. Of late direct humidity reading set is used as it facilitates work. In humidity and air conditioned chambers there are automatic recorders, and contrivances exist for automatic regulation of temperature and humidity. The use of thermometers, etc. will have to be popularised at least with seed-coon producers

Baskets, etc. - Baskets for holding leaves at feeding time are essential and are made of split bamboo of a convenient size. Pressed card board plates are used for "Chawki" leaves.

Charts, etc. - In all Government Institutions for ordinary rearings standardised charts are maintained for rearing spring, summer, and autumn crops with reference to humidity and temperature. Feeding, cleaning, and other operations are also regulated according to these charts.

Material for cleaning. - Paddy husk is almost universally used for its obvious advantages. Now a days in experimental stations 'Charred husk' is more freely used instead of raw husk. In branch feeding calcarious (powder) earth is used, though no cleaning is done. This is done to prevent muscardine, as these rearings are had in open rooms or barracks.

Feeding

Feeding and Spacing. - The number of feedings varies according to age of worms and season. In the spring season from 1st to end of 3rd age, worms are fed 6 times a day, and properly 'sized-cut' leaves are fed. From the 4th age onwards the number is reduced to 4-5 times a day, and the worms are fed entire leaves. In summer and autumn crops the number is increased according to temperature, etc. The feedings are all done following the fundamental principle, viz., that of "Appetite" and "Appetite Curve" which varies according to environment and the period in each age. The number of feedings in Japan per day is comparatively less, for three reasons, viz., the temperature is low, leaves are thick, and leaves do not dry soon. Great care is taken in feeding uniformly in the trays, which are comparatively of a smaller dimension and as such admit of better feeding. Spacing between tiers has already been referred to. Worms as a rule in a tray are thin and evenly spread out. Overcrowding of worms is never to be seen in Japan, ~~Overcrowding of worms in~~ which is one of the sore points in Mysore rearings. Ordinarily in experimental stations, etc. worms are reared 'Cellular', i.e., worms of individual moths are separately reared. Consequently there is more space. In raiyats' rearings chawki of a 100 layings usually occupies 1½ to 2 Sq.ft. which gradually increases to 150 to 200 Sq.ft. at the end of the rearing. The importance of proper spacing cannot, but be emphasized too much.

Methods of rearing. - "Cellular" method is adopted in experimental work, and in producing 'Cellular ~~method.~~ seed" In experimental stations for producing 'Original seed' for use of seed makers and for use of station, generally worms of two moths are reared together in a tray. This cellular method is costly, but is very scientific as it facilitates easy elimination of diseased batches. It would be necessary in all Government Farms to minimise the size of trays and rear worms cellularly in the interests of improving the quality of rearing. This would in the beginning increase costs on mulberry leaf, but it would be of great advantage in the end. Seed-makers adopt the cellular

cellular method or more especially rear worms of 2 or 3 moths together. Village rearers generally have combined rearing of worms of 5 to 6 moths per tray as this is more economic.

"J o s o i k u":- This is the branch feeding, and it consists in feeding entire cut branches instead of entire leaves after the 3rd stage of worms. The rearing house may be the ordinary house of the raiyat, or a barrack, or a pendal put up in an open space for the purpose. On a raised platform of about 2' in height, trays are arranged from 6' to 12' in length, and 2' to 3' in breadth. Such trays may be contiguous, and to the length of the entire room. Usually there is no tier above tier as it is very inconvenient of handling. Cut branches are arranged in trays and worms sprinkled over. Worms are fed once or twice a day by arranging branches. This sort of feeding continues till the worms mature. No changing of bed is done during the whole rearing period. This method is very economic as it spares labour in feeding of worms, and picking of leaves. The average harvest for 100 layings is 100 lbs., and in better grade rearings 125 lbs. is not unusual. Experiments in this method of rearing are necessary in Mysore.

Rearing according to method of feeding. - Of the several methods in vogue, cut leaf feeding is the best. The worms in this method are fed with cut leaves from hatching till the end of 3rd or 4th stage. This method is costly. In the second method young shoots picked from the bushes suitable for chawki worms are cut into small pieces of 5" - 6" in lengths, and arranged across in the trays containing worms taking care that all leaves are spread out properly, and the next feeding is given after all leaves have been eaten up by the worms. Leaves do not dry soon, and the number of feedings can be minimised. In the third method the shoots are even longer and keep in "Condition longer." This is a very economical method. But skill is necessary in arranging shoots, otherwise young worms remain under bed and are lost. According to recent estimates full shoot and cut shoot methods during chawki have gone up to 40 % of the total rearings. Branch feeding

feeding during advanced ages is used by 60 % of rearers in spring season all over Japan. In Saitama Prefecture it is 90 % in spring season. In summer and autumn, the percentag is very little. On an average worms of 100 layings occupy about 150 Sq. ft. space in the advanced age, and the yield per 100 layings varies between 100 to 120 lbs. and 125 lbs. is not rare. Roughly with reference to quantity there is a difference of 6 to 10 % only between this and the ordinary rearing. This is more than balanced by the considerable reduction in expenditure. Experiments are being conducted on a large scale to have worms reared outside of houses, and also on bushes in the mulberry garden itself. Results cannot yet be said to be satisfactory.

Essential Statistics of Rearing. - On an average each rearer rears worms of about9 egg cards (one egg card contains 28 layings), produces about 350 lbs. of cocoons. 150 Kwan of leaves give 10 Kwan of cocoons (1 Kwan = 8.27 lbs.) which give 1.00 Kwan of silk. 80 % of rearers carry on rearing as a subsidiary occupation, and 20 % as a large scale industry. Of the total number of persons engaged in the industry, 66% are women, and 34 % men. Altogether there are 19,700 rearers' Guilds with a membership of six lakhs. Most rearers have their own gardens, about 6 - 10 % purchase leaves. It is very uneconomic to purchase leaves and rear excepting in the case of seed cocoon rearers.

Seasons for rearing. - There are three rearings a year now in Japan as against only one in former days. This has been possible as a result of 'Artificial Hatching of eggs.' The first rearing is the spring rearing. Eggs hatch about the first week of May and crops are harvested in June. This crop is mostly of univoltines and a small quantity of bivoltines. 99 % of rearings are first generation of cross-breeds and are of previous year's crop. Eggs are subjected to cold storage from February to Middle of April. A small percentage is yet hatched without 'Cold Storage' operation.

In

In this case hatchings are irregular. The average temperature in rearing houses is 70° F, and highest 78° F, and lowest 65° F, the average humidity percentage is 75, and highest is 94, and lowest 50. Spring crop forms 50 % of the total crops.

Summer Crop. - Eggs hatch by about the 25th July and harvests are made between the 15th and 20th August. 50 % of the eggs used for summer crop are from previous years. hibernating eggs submitted to cold storage from beginning of February to the beginning of July. 50 % of the eggs are from eggs of the same year artificially treated. Summer crop forms 30 % of the total crop. Use of eggs of same year, and with artificial treatment is becoming more and more common as against use of previous year's eggs.

Autumn Crop. - This crop forms about 20 % of the total crops. 5 % of eggs are from spring seeds of Bivoltines submitted to cold storage till the end of August. These eggs are deposited in cold storage 50 hours after laying. 95 % of eggs are from summer crop as cold storage of layings of previous year would be too long and useless for practical purposes. The above eggs are subjected to cold storage 40-45 ~~days~~ hrs after layings, and kept for 20-70 days at a temperature of 40° F. Eggs are removed between 20-70 days at the desired time and treated artificially. In 10 days after treatment eggs hatch. The average temperature in rearing house is 82° - 83° F., highest is 88° F, and lowest 75° F, and respective humidity percentages are 80, 90, and 50.

Varieties, etc. of silk-worms. - The number of varieties, etc. of silk-worms in Japan was too much. The first step that Japan had to take was to reduce the number by process of elimination. Even the existing list of varieties is fairly long. The most important ones that are in common use are as follows:-

Spring Univoltines:-

Japanese - (1) Nichi 1, Nichi 10, Matamukashi.

Chinese - (2) Shi 4, Shi 5, Shi 7, Shi 8, Shi 13.

European - (3) O 7, and O 10.

Summer

Summer and Autumn. -

Japanese - Nichi 101, Nichi 107, Nichi 110.

Chinese - Saihaku Shi 105, Shi 102, HO, and En.

The several important cross-breeds are for Spring Nichi 1 x Shi 4, Shi 4 x Shi 5, Shi 7 x O 7, Shi 13 x O 16. White varieties are more in vogue than yellows.

Summer and autumn crosses are. - Nichi 107 x Shi 8, Nichi 107 x Saihaku Shi 105, Nichi 110 x Shi 102, HO x En.

- Comparative essential data of the above races:-

Name of Variety.	Total period of rearing.	Colour of Chawki.	Colour of mature worm.	Percentage of Double Cocoons.	Weight of 1 litre of cocoons.	Quantity of silk per cocoon.	Length of silk filament(Average)	Average Denier.
Nichi 1	31	Black.	Reddish	6.2	187.5 Grs.	.213 Grs.	608 revolutions.	3.12.
Shi 4	29	"	Bluish	3.6	139.9	.202	602	3.02.
Shi 5	29	"	"	2.6	150.5	.217	607	3.00.
Shi 7	30	"	Reddish	2.9	166.0	.229	632	3.05.
O 7.	32	Brown-Black	"	1.8	160.6	.239	659	3.01.
Nichi 107	23	Black	Bluish	9.8	171.0	.143	469	2.71.
Nichi 110	22	"	"	13.1	158.0	.145	469	2.78.
Shi 101	29	"	"	12.1	108.0	.145	520	2.70.
Shi 102	20	"	"	6.2	145.0	.137	475	2.64.
Saihaku 105	20	"	"	5.4	127.0	.147	489	2.83.

It is seen from the above that univoltines are better than bivoltines in several respects. The denier of the several breeds is "Thick", and is very inconvenient in producing 14 denier silk which is the requirement of the United States of America purchasers.

Seeds of original races are prepared by the prefectural experimental

experimental stations to the extent of 25 % of the total demand of seed-makers, and the rest are prepared by the seed-makers themselves. The Imperial Sericultural Station evolves new breeds and distributes a small quantity to prefectural stations which multiply it, and distribute to several seed-makers.

COLD STORAGES, ARTIFICIAL HATCHING AND INCUBATION OF EGGS.

Technically speaking systematic cold storages, and artificial hatching have been two essential boons in the Sericultural industry of Japan. In the old days eggs were used to be submitted to cold storage operations by depositing large quantities in ice-caves called "Fuketsu" which are to be found in many places in Japan. Mount Fuji caves were famous for this. Cold storage in olden days cost practically nothing, but the variations in temperature remained uncontrolled, and the conditions varied from place to place. Gradually this was abandoned to a more favourable type of cold storage. The inspection stations in counties constructed a cold chamber of ordinary wooden planks, double walled, and with double walled chambers whose walls were filled with saw dust, cork, and other non-conducting material. The outer double wall of the chamber was filled with ice in season. Between the ceiling of the chamber and the tile roof ice was packed in saw dust. The inside chambers were used for storing eggs of not only the stations, but also of seed-makers. The temperature obtained did not vary as much as in "Cave" (Fuketsu). All the seed-makers keep the seed in this chamber under the management of their guild, subject to control of the Seed Inspection Station. The charges are borne by the guild, and the members have to pay a graduated sum according to the quantity to be stored, period of storing, etc. Even now, these cold storages are in existence. Of late, the tendency is to have ferro-concrete buildings with ammonia plants. This is the best type as temperature and humidity can be regulated. Results are

therefor..

therefore very satisfactory. Such a cold storage would be absolutely essential here for two reasons, viz., we could conserve eggs of grainages and distribute them when there is demand which would place the grainages on a sounder basis avoiding uncertainty, and it would enable us to carry on Genetical work scientifically in silk-worm races.

Generally eggs are confined to cold chamber in the beginning of February, in **Japan**, the temperature being 34° F. till the middle of April for spring varieties, When these are removed and incubated according to standard methods. As regards summer varieties cold storage starts in February and continues till the beginning of July, and in the case of autumn crops (only 5 % are treated like this) the cold storage continues till the end of August.

In conserving eggs it is necessary to know the particular period of the embryo in the egg. In the univoltines and bi-voltines it is the resting period, and this embryonic stage lasts from middle of December to about middle of January. Bivoltines for rearing in summer are kept in cold storage till the end of May. The eggs are then removed, kept at 60° F for 3 days and subsequently at 65° F for 2 days. The embryo attains the maximum length period. The seeds are again confined in cold storage till they are required for incubation. This may be termed the "Duplicate System" of cold storage. This is a very important method in the treatment of eggs.

Artificial Hatching. - The several important methods by which eggs can be artificially hatched are:- Treatment by hot water, treatment by Hydrochloric acid, and electrical method.

Hot-water Method. - This is perhaps the oldest having come from China. Even to-day it is common in Kwangtung. The eggs to be treated after preliminary processes are dipped in hot water at a temperature of 110° - 115° F for 4-10 seconds according to voltinism, period after depositing, etc.

This

This method though simple and economic, the results are not so good as in the treatment with Hydrochlotic Acid.

Hydrochloric Acid Method. - This is the commonest method now in Japan. Eggs to be treated, after preliminary processes are treated in Hydrochloric Acid of 15 % strength at 115°-120°F for 5' - 10' according to voltinism, period after laying, etc. In Inspection Stations, and in grainages, arrangements are made for hot water jackets in which celluloid tubs containing hydrochloric acid of the required strength are held semi-floating. The egg cards are all held in a frame, and the entire frame is immersed in the celluloid tub when the required temperature is got. In Companies like - Fukyasha, and Ganze, thousands of egg cards are treated in a day. This method is both economic and simple and gives very satisfactory results in hatching.

Electrical Method. - Of late, this method has been perfected. 99 % of eggs electrically treated hatch and give satisfactory results in rearing. Egg cards are held inside hollow metallic cylinders provided with discharging needles. High pressure pulsating current is passed for about 6'-8'. The one great draw-back of this apparatus is that it is too costly - standard set costing as much as Y. 1,200.00 besides costs of erection. Otherwise, it is satisfactory, and it is neater in operation than the hydrochloric acid method. Kyoto College has perfected this method, and is using it freely. A few seed-makers have used it successfully.

Treatment of Bivoltines. - Spring Bivoltines are treated as follows:-

Spring Bivoltines.

(1) For use of Summer Crop.

(2) For use of Autumn Crop.

The "White eggs" are as a rule rejected, because they do not give good results. For summer crop the "Kurodane" or eggs that would turn black are selected, and treated artificially by means of hydrochloric acid and subsequently hatched. For use of autumn there are two methods, viz., the eggs

eggs are treated artificially, and 30 hours after treatment are subjected to cold storage at 40° F for about 20 days. Then they are removed, incubated, and hatched. In the other method, the eggs are subjected to cold storage at 40° F 40-45 hours after laying for a period between 20-70 days, & treated artificially. It is important to note that the strength of acid used is 20 %, and time is also longer.

I n c u b a t i o n. - Incubation is very important with univoltines and bivoltines. Univoltines removed from cold storage in the middle of April are kept in a place or chamber where the temperature is raised to 60° gradually. At 60° F, they are kept for 3 to 4 days and the temperature is gradually changed to 70° F to 74° F in the course of a week. The eggs are hatched at 74° F. Spring bivoltines are treated in a similar way, but, the hatching is done at a temperature brought to 77° - 80° F, as at 70° -74° F, bivoltines become bad. It is desirable to have here temperature regulated chambers for incubating univoltines and bivoltines for use of annual rearings at least.

SILK-WORM SEED AND ITS MANUFACTURE.

The total quantity of silk-worm seed required annually in Japan is about ninety crores of disease-free layings. Of this, about two crores are for reproductive purposes, and the remaining eighty-eight crores of layings are industrial seed. All this seed has to be examined for pebrine. This enormous work requires an organization which should not only be extensive, but, efficient. Government have taken up the work of examining seed themselves by establishing Seed-Inspection Stations, whose work has already been described. The Experimental Stations supply "Reproductive" eggs to the extent of 25 % only, and the remaining quantity is manufactured by seed makers. All industrial seed is prepared by seed-makers. These seed-makers are licensed by prefectural governors, and rigid standards are prescribed for appointing them. Their total number in 1929 was about 7,000. Each prefecture and each country has its own seed-makers. The idea that seed should

should be from a particular locality alone no longer exists, though some rearers prefer to have seed of particular localities, or of seed-makers. Each seed-maker on an average prepares 4,300 egg cards (one egg card contains 28 layings). Spring egg cards are sold at Y. 2.00 - 2.50 each, and summer and autumn ones at Y. 1.00 - 1.50 each. Fairly big seed-makers manufacture nearly 30,000 egg cards and earn as much as Y. 8,000.00 to Y.10,000.00 per annum. Even small makers who produce between 3,000 to 4,000 egg cards earn, Y. 1,000.00. This industry is lucrative in Japan as the price of layings is very high, for the ordinary rearer knows the benefits of good seed. Some companies likd Gunze and Katakura, manufacture several lakhs of egg cards.

Usually a seed-maker rears seed cocoons for reproductive purposes himself, but seed cocoons for preparing industrial seed are reared by other rearers under him. In such cases the whole group is regarded as one concern, and the seed-maker is held responsible for all under him. The Inspection Station exercises control over both. A seed-maker who gets his seed cocoons from his sub-workers, purchases from him. In some cases share system is also adopted and there are 431 guilds and its branches of seed-makers in all. 70 % of summer and autumn seeds are hatched by artificial treatment by Hydrochloric Acid method and 30 % are submitted to "Duplicate Cold Storage" system.

There are three kinds of seed, viz., cellular, i.e., each laying being separate as in egg cards, and this forms 79 %; second is combined layings, layings of 35 or 100 moths are laid on one sheet and this forms 15 %, and loose seeds as in Italy form 6 %. The last named one may be in bags containing 30 grams or 19 grams or 9½ grams.

SALE OF SEEDS.

The seed-maker may sell his seed directly to rearers. This is possible when the quantity is small. He may have an agent of his own, which is possible when the quantity is large

large. The ordinary method is to effect sales through a broker who is a licensed vendor, and who should conform to certain regulations of sericultural law. The broker may get a commission on actual sales effected, or he may purchase seed at rebate rates and sell for himself. There are several thousand seed-brokers. They may sell at their own shop or hawk about. Hawking is prohibited in certain prefectures. Brokers in certain prefectures are required to have small ice-packed storages for conserving silk-worm seed during season to prevent seed being spoiled.

Mention has already been made of the equipment of rearing houses of seed-makers. During the rearing period the crops are examined for diseases, proper development of worms, etc. by the staff of the county inspection station constantly. This becomes possible as there is adequate staff. When the crop is harvested successfully a certain percentage of cocoon is submitted for microscopic examination in the county guild. Moths from sample lots are made to emerge 3-4 days earlier than in the normal case. This is possible by keeping such lots of cocoons in a chamber whose temperature and humidity are regulated for that purpose. For example, when the average rearing temperature is 70 ^{o}F, and humidity 75 %, the chamber in which "Sample lots" of seed cocoons from which forced emergence of moths is desired the temperature is regulated constantly at 86 ^{o}F, and humidity to 85 %. This treatment accelerates emergence of moths 4-5 days earlier. Such moths are tested for pebrine and if the percentage is found to be more than 5, the cocoons are rejected for seed purposes. Such small chambers for forced emergence of moths in our grainages would go a long way in effecting economy and increasing efficiency of our work. After success in this test the seed cocoons are all sorted. Double cocoons are removed, as also irregularly shaped and flimsy ones. Only cocoons of average uniform shape and size and of thickness of layer are retained. These operations are hand done. In rare cases ~~for~~ size machine is used. Floss of cocoons is

removed

removed by floss-removing devices. This is used as high grade silk waste. The cocoons are arranged in trays in the usual way. Temperature is kept at about 75° - 80° F, and humidity is regulated to about 75 %. Where male and female cocoons are to be kept separate as in preparing crosses, etc., they are separated by male and female cocoon separating machines. If the quantity is small, males and females are separated during the larval stage. It takes 20 days in spring, and 13 days in summer for moths to cut out. Pairing is done in dark room. After the pairing is over female moths are consigned to tin rings, arranged on egg cards or in cellules, or on sheets of paper according as the system is that of egg card, or of cellules, or combined. After three or four days, all female moths are transferred to regulation cellule boxes which hold 28 moths in serial order, and numbers of egg cards are correspondingly given to cellule box. The egg cards are all arranged serially, and according to race, etc. in egg card holders, and kept in a store room of the seed-maker, prepared for that purpose, where required temperature and humidity are had. Moths contained in the card-board cellules are all taken to the local inspection station, and deposited there for examination, which takes place as already described under "Inspection Stations." There are two kinds of examinations, viz., percentage, and cellular. In the former, 10 out of 100 moths of industrial seed of a particular batch, race, and of seed-maker are examined, and if the examination indicates not more than 1 % of pebrine, then the eggs are certified good. Should the examination give more than 1 % in the 10 % of the moths examined, then, re-examination is done. This method is adopted for moths used in preparing cards, but, in case it is combined laying system, i.e., where 100 moths are made to lay eggs on one sheet, the examination is repeated, and in case the percentage of pebrine is less than 10, then the sheet is passed; otherwise, the whole lot is rejected. In the cellular method each moth is examined separately. Generally ten fields are examined for each moth. In the egg card system rejected

layings

layings are removed, and good substitutes are gummed. 40 % of the total examination is by percentage examination, and 60 % is individual moth examination. First examination of moths is not charged for. For re-examination there is a small fee. Some prefectures are now contemplating to charge a small nominal fee for first examination also.

Small seed-makers generally do their own work with the assistance of their family members, employing a few girls for pairing, etc. of moths. Bigger seed-makers employ full time experts for rearing, and for preparation of seed. As a rule the seed-makers are all trained men, and are fully conversant with techincal, economic, and organization aspect of the work.

Reference has already been made as to preliminary examinations of moths from seed cocoons to be preserved for making seed. In addition to this, the seed-makers in their guild get examination of eggs for pebrine. From a batch of seed cocoons used for forced early emergence of moths, 50-100 layings are taken, and from each laying 50-60 eggs are microscopically tested by the expert of the guild. Such of the batches that do not satisfy the required tests are rejected for propogation purposes. Each seed-maker of a guild contributes Y. 40.00 per year for expenses connected with employment of expert, maintenance of cold storage and other charges. These charges differ from guild to guild. The egg cards, sheets, or cellules of seed-makers are all stored for check and certificates in inspection station at the proper time.

During the examination of moths in inspection stations great care is taken to keep all batches of moths separately. All hygienic precautions are taken to see that mortars, pestles, slides, cover slips, are all well cleaned. There are standardised methods for each operation which ensure both economy and efficiency. Microscopic examiners are all girls who have had their training in one of the

inspectior

inspection stations. They are paid about Y. 0.70 to Y. 1.00 per day of 8 hours. The examination season lasts from August to October or November, when all of them are sent away. For a group of 5 to 6 examiners there is a supervisor, who checks the examination by inspecting 10 % of the work of each girl.

Reference has been made already re' mechanical equipment of inspection stations. Suffice it to say here that the moth crushing machine used does not only turn out more work, but, is economic, and allows operations to be done more hygienically than in the ordinary method.

Thus, the seed-making industry is a specialised branch spread all over the country and is a private enterprise under strict control of Government in virtue of Sericultural Law of Japan. It is lucrative, and absorbs men of education, technical training, and to a certain extent men of small capital. The commercial aspect of it is regulated in virtue of issuance of vending licenses to vendors, and admits of decent profits to all engaged in that business. Moreover, seed-makers are encouraged to have such breeds as are approved by Government institutions, who have determined them to be such as to be profitable in several respects.

SILK REELING AND ITS ORGANIZATION.

Japan till 1870 depended for reeling on old reels. The industry was mostly cottage one, and in some cases it was in the hands of small capitalists. The position was just analogous to what it is in Mysore to-day. From the figures given elsewhere, it is seen that out of a total production of about 9 crores of lbs. of silk, nearly 8 crores of lbs. is manufactured in filature, and about 40 lakhs of lbs. in foot-reeling and other establishments, and the remaining 60 lakhs of lbs. is double cocoon silk. Out of the total reeling establishments of about 77,000, only 925 are of 100 basins and over. The silk produced in foot-reeling and other cottage establishments is not exported for two reasons, viz., that standardisation in reeling cannot be practically effected

effected, and that large quantities for export would not be available. This is one of the reasons why larger filatures producing large quantities came into existence rapidly.

Economic Types of Filatures. - In 1927, out of 2,486 concerns, 1,293 were those managed by a single individual, 68 were of family companies, 137 were of Joint Stock Companies, 494 were of Limited Companies, and 494 of Co-operative Guilds. Filatures with over 250 basins are mostly to be found in Joint Stock and Limited Concerns. Messrs. Katakura Filatures have altogether 21,000 working basins. This is the biggest filature company of the world. Limited Companies are doing good business now.

'Co-operative Filatures.' - This type is a new one. These are very popular in Gumma and Nagano prefectures. The members of a guild who are rearers, raise their own cocoons especially of high grade and deliver them to their co-operative filature, or the guild collects them and passes on to its filature. The girls of these rearers attend to reeling. Employing of girls is also becoming common now. This is due to restriction on age of girls to be employed interfering to a certain extent. These filatures work now almost continuously. This type of filature has some advantages, viz., that it gets loans at cheaper rates, and hence costs of production become less, and moreover, girls of rearers are employed on work during off season which brings them income. Cocoons are paid for according to "Index Value" of silk on market rate after actual tests. Moreover, the profits of the filature are distributed within the locality. There is practically no expenditure on purchase of cocoons. The filature may advance money to rearers when required by them. In other cases, where cocoons of members are not paid for, payment is made after selling silk, making due deductions for manufacturing charges, etc. These filatures have between 50 to 100 basins each, and very rarely 200 basins. This type of filature is not subject to such violent financial troubles as the ordinary type is. It has its dis-

advantage

disadvantage of party feeling. Attempts are being made to curtail it by all means, and it is thought that this defect would be removed sooner or later. This type of filature is suitable especially in places where rearers find it difficult to dispose of their cocoons.

COCOON MARKETS.

Cocoon markets are as follows:- Bargain may be made at the house of the rearer. This, of course, is the time-honoured method, and has its obvious disadvantages. This is comparable to cocoon markets in Mysore, but with a little difference that Yokohama Silk Exchange quotations being open knowledge to all every day, the seller is in a better position in Japan than in Mysore to safeguard his interest. This cocoon market is generally for small purchasers.

When purchasers are on a big scale sales of cocoons may be effected at the filature itself. The rearer brings his harvest in a basket containing 13.3 lbs. of raw cocoons as the average sample, and on the basis of prices of cocoons as per "Index value of silk content," settlement of rate is made. This "Index Value" has already been referred to as "Kakeme". Kakeme - this is also the price in Yen of that quantity of raw cocoons that produce 13.3 lbs. of silk. Suppose the rate per Kwan (1 Kwan = 8.27 lbs.) of cocoons is agreed at Y. 5.00; it is understood that the filature will pay at that rate if the silk content on actual test reeling of 400 Momme of cocoons is found to be 10 %. Should the cocoons give 12 % or 8 %, the payment is made in proportion, i.e., $\frac{\text{Y. } 5.00 \times 12}{10}$ = Y. 6.00, or $\frac{\text{Y. } 5.00 \times 8}{10}$ = Y. 4.00 per Kwan. This is very fair for the seller as well as for the purchaser. It has the minimum element of speculation. Cocoons may be ~~immediately~~ paid in due course of time according to settlement, or the filature may have it as spot transaction and pay immediately after weighment, having settled prices, or, the filatures may purchase in open market, such as that of a guild. In any Sericultural

village

village there is a guild of rearers, and all the rearers, or at least its members, bring the cocoons, and have the sample lots open to inspection of purchasers, viz., agents of filatures, or brokers. First, the 'Kakeme' is settled and lot by lot, cocoons are knocked by the committee of 2 or 3 persons appointed by the guild for that purpose to the highest bidder. In such cases, payments are made to the guild by the filature or broker to the extent of 80 % of the total amount. The balance is paid for after actual test reeling is made for percentage of silk and reeling quality This test reeling may be made in the prefectural station, or in any one of the accredited filatures agreed upon by the selling guild and the purchaser. For all such transactions, the guild charges a small commission of Y. 0.25 per Y.100.00. In some guilds even this is not charged for. Test reeling is done for 400 Momme of raw cocoons (1 Momme = 3.75 grammes) Again, the purchases may be effected through brokers. This system has all the drawbacks of the existence of a middle-man, who is unscrupulous. The broker may merely negotiate for particular transactions, or he may purchase cocoons himself and sell to filature. Generally, he has his own go-downs to store cocoons. The rearer brings the cocoons and after settlement of bargain, leaves the lot with the broker. He is licensed by the Governor, has to pass a practical examination held in experimental station, re' quality of cocoons, reeling, Sericultural Laws, knowledge regarding distinguishing cocoons of various varieties of silk-worms and other practical things. Restrictions are imposed to see that abuses are minimised. The one standing complaint against the broker is that he mixes bad and good cocoons.

There is another kind of market, viz., a number of rearers and brokers may form themselves into a joint stock concern with as much capital as Y. 50,000.00. Such a company has equipment for drying of cocoons partially, and an open hall for conducting transactions. In the big hall a sloping plank 10' x 6' is fixed about 2' high from the

floor

floor. On either side of it bidders of cocoon sit. One of the Secretaries of the Company sits at one end, the rearer discharges all his cocoons on the plank. After inspection each bidder writes his bid in a lacquered cup and keeps it inverted. All these are collected and the highest bidder gets the cocoons. The seller gets a receipt indicating weight of his cocoons, money to be paid to him, etc. He gets his money in two days. The seller has to pay commission of 0.3 % and the purchaser a varying commission of 1 % to 1.5 % according to the volume of business done. The cocoons are partially dried, i.e., to 50 %, and handed over to the purchaser. The seller effects payment within a week's time. This system is an improvement over the purely competetive one in as much as every one bids without knowing the bid of the other. The sales are very rapid. It also avoids the mixing of bad and good cocoons as by brokers. Yet, this lacks the scientific aspect, viz., there is no test reeling and cocoons are paid on "Apparent" tests, ~~and moreover no exact co-ordination is maintained between Silk Exchange quotations and quality of cocoons.~~

All the above markets transact business in raw cocoons only. Of late, much encouragement and attention are paid to trade in "Conditioned" cocoons. This method is undoubtedly the most scientific. For this purpose, "Cocoon conditioning guilds" are established. Some of the prefectures have in each County a guild of this type. A typical guild has a capital outlay of about Y. 180000.00, out of which, about Y. 56,000.00 are contributed by Government, as a subsidy towards apparatus, etc. The rest of the capital comes from contributions of shares of Y. 10.00 each. The members are rearers and other sericulturists, generally of the same County. The guild has 2 or 3 or 4 sets of big drying apparatus, each drier conditioning about 10,000 lbs. of cocoons a day. There are fire, rat, and moisture proof ferro-concrete buildings for storing Cocoons. The rearers bring the cocoons to the guild, which takes the standard sample of 400 Momme and sends over for test to the experimental station. ~~Thus~~, Each

Each rearer has the certificate of his lot of cocoons, a duplicate being retained by the guild. The cocoons are all mixed and "Conditioned", stored in the chambers ~~and stored~~. When filatures wish to purchase lots are bargained at the market price determined by index value, etc. The payments are all collected by the guild. The rearer gets an advance to the extent of 70 to 80 % on his cocoons. Final payments to each seller are made proportionately to quantity and quality of cocoons. The system of computation is complex, but, several guilds have their own indices prepared for this purpose. Nearly, 15 % of the trade in cocoons now is in "Conditioned Cocoons."

CONDITIONING OF COCOONS.

Steaming of cocoons is no longer done in filatures. Instead, hot air cocoon driers are extensively used. In small filatures ordinary chambers of 15' x 7' x 10', built in brick and mortar are used. These chambers are heated by means of steam pipes laid across the floor. On both the longitudinal walls inside the chamber fans worked electrically are installed, so as to keep temperature even while working. Trays are charged with cocoons, kept in stands, and confined to an active chamber for a period of 8 hours at a temperature of about 180° F. The cocoons condition well. This system is in vogue even in some big filatures. The chambers are big in such cases. Use of electrical heaters has been found to be very costly, compared to steam heating of air.

High class and up-to-date filatures and cocoon drying guilds all use modern apparatus, such as, Tabata, Imamura, Obikawa System, etc. These apparatuses are all what may be termed continuous movement extensive belts driven on rollers. Between Tabata, Obikawa, and Imamura type driers, there are only few differences, the essentials being the same. To describe one is to describe all. The chamber itself is 65' x 20' x 15'. At the end of the longitudinal walls on each side there is a system of rollers on which

wire

wire belts to the full length and breadth of the chamber move continuously by means of motion conveyed from a pulley. In each chamber there are five such belts. The entire chamber has iron frame work to support the belts in motion. Cocoons are filled at the top belt which moves from direction A to B, and at the extremity B discharges cocoons over the next series of belt, which moves in the opposite direction, and from there to third belt which moves from A to B and from there to fourth one which moves in the direction B to A, and to fifth which moves from A to B and finally discharges to the receiving platform. The motion of the belt is slow, and it takes practically 8 hours for each lot of cocoons to move from first belt to exit finally. The top layers are kept at a temperature of 170° F , and the bottom layers at 200° F. The chamber has a system of steam pipings. Filatures have been extensively adopting this method of "Conditioning of cocoons." One chamber can condition in a day about 10,000 lbs. of cocoons. Guilds where these apparatus are installed charge about Y. 0.25 per Kwan of cocoons for conditioning, or conditioning charges per lb. would be a little less than 8 pies.

The Chiba System of Drier. - This consists of a set of vertical boxes. Each box is 1' x 6' x 6'. Cocoons are filled and hot air passes from side to side. It is reversed from side to side periodically. This system has not come into prominence.

The conditioned cocoons are all packed in moisture-proof bags of standard size, and stored in store house . The old type store houses are all 2 to 3 storied buildings of ordinary walls, well ventilated, with racks for keeping bags. The roofing is tiled, but, there is always a ceiling to the top storey. The modern type of stores are all ferro-concrete 2 to 3 storied, double walled buildings with standard chambers lined with zinc sheet. Great care is taken in storing cocoons, and to see that no fungi attack, and insect and other pests do not destroy cocoons. In the guild store houses, any one can store his cocoons provided they are conditioned. The charges are on a graduated scale according to period of storage, etc. sorting

SORTING AND GRADING OF COCOONS.

These operations are very important. All the cocoons are graded according to crop to which they belong, viz., Spring, Summer, or Autumn, as the quality of cocoons differs considerably for each season. The cocoons are again graded according to varieties, viz., cross-breeds, between Japanese Chinese, Japanese x European, etc. This is necessary as denier of each variety differs, and mixed reeling of cocoons would inconvenience reeling operations, etc., as sizes and shapes vary, and as there is slight difference in shade of colour. Within the same lot, cocoons are sorted for quality by removing inferior ones, deformed, and 'Pupa crushed' cocoons. This sorting is effected in several ways. In high grade filatures, there is a special chamber fitted with slanting openings in walls and with wooden holders for cocoons. When cocoons are poured into the wooden holder, they slide on desks whose surface has glass plates illuminated electrically from below. Operatives pick out the above mentioned bad cocoons, and separate out good ones. The good ones are either passed to the stores, or to cooking rooms according to requirements. In other filatures, the operations may be simple, and sorting is done on endless moving belts. It is needless to add that yellow cocoons are always kept separate from white ones. Grading and sorting of cocoons may not cost more than 1 % of the total expenditure on costs of production.

COOKING OF COCOONS.

This is the most important preliminary operation in reeling as it affects reeling, and costs of production. Cooking in filature is combined, i.e., cocoons are cooked in one place, and distributed to reelers separately. There is no cooking basin attached to a reeling unit. In small filatures cooking is done in porcelain basins provided with water supply, and steam connections. The basins are cylindrical about 13" in diameter and 14" in depth with a false bottom. and a plank cover with handle. There are two

methods

methods of cooking, viz.; sinking and floating. For lower grade cocoons sinking system is good, and for better grade cocoons floating system is suitable. Measured quantity of cocoons is conserved in cooking basin for 1½' at 180° F, holding and evenly spreading the cocoons by means of the plank, then, steam is let in gradually to raise the temperature to 210° F, and cocoons are kept at the latter temperature for 3'. The plank is again revolved to evenly distribute the cocoons, and again (i.e., 3' after) is removed and cold water is sprayed over the cocoons, shutting the steam. Again steam is let in till a temperature of 180° F is got, and operations continue for 2' ~~or~~ also. Steam is again shut and cold spray done again, and cocoons removed. This is the sinking system in which cocoons contain ~~inside~~ water inside. In the floating system the treatment is altogether different. Cocoons are encased in a cage and immersed in cooking basin at 210° F for 30" only, and transferred to basin at 150° F for 5", and then to basin at 210° F for 6 ', and finally to tubs containing water at 120° F. Floating system is adopted by 70 % of filatures, and sinking system by 30 %. The merits of each system are as follows:-

Sinking System.	Floating System.
Out-put per reeler is less.	Out-put per reeler is more.
'Boil off' less.	'Boil off' more.
Rendita - good.	Rendita - Not so good.
Minor defects few.	Minor defects more.
Colour is poor.	Colour is good.

This combined cooking of simple type serves well in small filatures. A combination set of 7 to 8 basins can easily handle requirements of 100 ends in reeling and with 3 girls ~~working~~ Cooking for Japanese cocoons.

In big filatures, cooking in machinery is the general rule. There are various types of continuous cooking machinery. The essential principle applied is to treat cocoons at differential temperatures for definite periods according to quality of cocoons depending upon season, breed, etc. To accomplish this

this end mechanically, wooden chambers of rectangular shape and of length varying from 20' to 25', and width of 3' and height of 3' with the upper surface open are devised, there being three different contiguous compartments of varying lengths, such that when cocoons in boxes are immersed they receive differential treatment in each chamber as regards temperature & time. The boxes containing cocoons move in the chambers by automatic arrangements. In the first chamber, the temperature may be 200° F, and in the second 210° F (i.e., boiling temperature), and in the third 180° F also. For sinking system, there is an automatic spray of cold water. These mechanical devices are very essential in all big filatures, as cooking costs on "Skilled labour" are considerably reduced, and as large quantities can be dealt with easily, and in comparatively short time. There are various types of continuous cooking machinery. The most important are - Nakahara Shiki, Choko Shiki, Wakuda Shiki, Circular Nakahara Shiki, Furni Shiki, Kijun Shiki, etc. In Nakahara Shiki chambers are not completely separated, but, in Choko, all compartments are well separated. Both are rectangular boxes. Choko is preferable to Nakahara. Quantity of cocoons cooked in a day is about the same in both. In Wakuda's system, the chamber is a cubical box and the arrangement of movement of boxes is singularly well adopted for good treatment of cocoons for cooking. This is the most scientific one, and is a recent introduction. Kijun Shiki is not convenient in handling, but, is very good for high grade cocoons. One continuous cooking machine can cook about 2,500 lbs. of cocoons in a day and can easily serve a filature of 250 basins. An installation would cost about Y. 2,000 to Y. 2,500.

In small filatures, where cooking is done in porcelain combination set, the operations are in the hands of expert cookers. In continuous cooking machinery the operations are under supervision of an expert who starts the work, fixes the timings and temperatures to be given for each lot of

cocoons

cocoons of the day, and routine is done by ordinary cooking girls.

REELING.

Ordinary reeling machinery is simple compared to that of European one. The basin is of porcelain with false bottom, and has steam and water connections. Shapes and sizes vary. It is fixed in a table of pine wood. Ordinarily there is no Jette-boutte system. Instead, there is 'button' system. Reels are of about 24" in circumference. The fixtures are all simple. In a few filatures there may be mechanical end-finding arrangements, the brushes being small and light. The travellers have simple motion. Breaks for each reel may be independent. The revolutions of reels is about 200 metres per minute, and if cocoons are of very superior quality, the revolutions may be 250, and it is never below 170. When velocity is high elongation decreases, but, tenacity improves. The reeler herself knots the breaks in silk thread. In a few filatures separate knotters are also employed.

The button system of reeling requires more skill on the part of reelers. But, the silk is 'Clean'. Jette-Boute system is good for beginners and unskilful reelers, and silk produced is not so clean.

Merits of Japanese basin are - simplicity, cheapness, less power to drive, clean silk got on account of button system, re-reeling gives cleaner silk, easy to fit up, and easy to repair. All filatures in Japan re-reel silk, there being no direct reeling. Reeling is done sitting on stools in filature uniforms. Generally four to five ends are reeled. Kanega fuchi, and Gumma Sha filature basins are all made of metal like European basins. Reeling is done standing. The reels are directly over the reeling basin, and are 24" in circumference. The basin provides for reeling 8 to 10 ends by a reeler. Movement of reels is slow. The jette-boute system is of a peculiar type in which thread passes in a knife edge which keeps the silk clean. This basin is costly,

and

and capital expenditure required for installation is more.

Minorigawa Basin. - This basin is the sole purchase monopoly of Messrs. Katakura Filatures at present. The present day basin of Minorigawa provides for 30 ends to be reeled by one reeler. Ordinarily, one reeler can reel easily 20 ends. Reels are directly over the basin, and are made of aluminium and in two sizes, viz., of 1½ metres circumference, and the other of 24", and are circular. The velocity of thread is 15 metres per minute. There is continuous reeling, i.e., breaks are few as the velocity is less. The small reel silk has to be re-reeled. When there is a break, the reel stops automatically (the small reel). One unit length of basin is 8½ feet, and this has 30 ends. 20 end unit is 5½ feet long. Water in reeling basin is luke warm. There are buttons and jette-boutes. The latter are of a curved knife type. The actual reeling operation is simplified, and very neat. The agglutination of threads is complete. The merits of this basin are that it gives very even silk which is the most important factor in classification of silk, as it carries 70 % of marks. The highest seriplane panel from Minorigawa gives 95 %, while silk reeled in ordinary basins has not gone beyond 91 %. The ordinary basin on an average gives 83 %. Seriplane evenness silk while Minorigawa gives 90 % evenness. In 'Cleanness' it is just the same as ordinary raw silk, and in neatness it is inferior. On an average, ordinary basin gives 1¼ lbs. of 13/15 denier silk, while Minorigawa gives about ¾ of a pound. The quantity of waste is also more. Where high quality is concerned Minorigawa is undoubtedly a distinct and advanced march over the ordinary basin. Messrs. Katakura are now conducting experiments with this basin to reel 320 ends. Results are not yet known. The silk manufactured in Minorigawa is sold in New York to Messrs. Girli and Co.

Messrs. Hara and Co., big filature company of Yokohama have manufactured an automatic reeling basin. The ends are picked by electrical feeders. I have not seen this basin as not

not even Japanese Experts have been allowed to seed, except Mr. Hachiro Tanaka, who, however, explained the detailed working and added that much is yet left to be accomplished.

Messrs. Boeki Seizo Kaisha of Kobe have very recently manufactured a basin with a tension balance in the "Croissure System." When the denier of thread changes, there is an arrangement in the above balance by means of which rings fall or rise 1, 2, or 3 according as the variation in number of cocoons occurs from the objective ~~number~~ denier. The adjustments are possible for deniers ranging from 13/15 to 21/22 only. One person can attend to 40 ends which is possible as the reel motion is slow. These basins have not yet been put to large commercial use. The manufacturers claim a good deal for it. The silk reeled gives high seriplane averages. These basins can be bought in units of ten only. The prices have not yet been fixed. These basins are not yet monopoly of any filature.

Reeling Operation. - The cooked cocoons are kept at a temperature of 100° - 120° F in a tub by the side of the reeler. The temperature in the reeling basin is about 50° C for sinking system, and about 55° to 60° C for floating system. Very small brushes are used by the reeler for picking ends. These operations are very skilful, as rough handling would mean more silk-waste. The left hand in which cocoon threads are held is always maintained at a uniform height as this has also relation regarding waste. Threads are thrown in two ways, viz., "Cut end" throwing, or "Round end" throwing. The former method gives more quantity, while the latter gives better quality. Cut end throwing is adopted ~~to~~ for inferior grade cocoons.

C r o i s s u e r. - Generally, 300 twists are given for 13/15 denier, and 330 twists for 21/22 denier silk. The length of the croisseur varies according to "Thread angle" on the pulley system. Ordinarily it is 12". Proper croissuer is necessary for getting suitable cohesion and tenacity.

Re-reeling

Re-Reeling. - This is absolutely necessary in Japan as silk is reeled on to small 24" circumference reels, and the requirements of American Mill Owners are hanks of 147 centimetres. Moreover, the gum on the skeins at the corners has to be removed. Therefore all filatures have a re-reeling establishment. The reels are of 147 centimetres circumference and are fitted in stands having necessary friction motion wheels, etc. They are as a rule fitted up on both sides. There are steam pipes for drying the silk on reels as quickly as the operation is done. The small reels from filature are passed over to re-reeling establishment, and reeled directly after wetting them to soften gums. Generally, the number of re-reels is 70 % of the number of basins in a filature. One girl can look after 8 to 10 re-reels. During re-reeling, number of breaks is counted and skeins which give more than 6 breaks are rejected for export purposes. Sizing skeins of 225 metres are also taken during re-reeling for testing denier. For calculating average denier of a full skein in institutions counters are fixed to re-reels which record the total length of the thread in the skein. Knowing the circumference of the reel and other factors, denier of the skein is calculated. This is a more satisfactory way than the usual method of denier test, as the percentage of error is less. Some filatures have adopted this method.

SKEINING AND OTHER OPERATIONS.

After re-reeling, the skeins are removed, stretched, and passed on to skein making department. Skeins are all "and twisted. One operative on an average makes 700 skeins in a day of 10 to 11 hours. The skeins are then passed to dark room having Northern Sky-lights for inspection. Generally, 70 % are passed as first choice, 15 % second choice, 10 % third choice, and the balance is rejected for export, and used for home consumption. Each skein weighs about 70 grammes. 30 skeins are made into a book of about 2.1 Kgs. in the small hand press, chop tickets inserted, and tissue paper is wrapped, and packed into boxes usually holding 16 such

such books, (and each box net weight silk is 9 Kwan, (Each Picul = 16 Kwan = 133 lbs.), and sent to the exporter at Kobe or Yokohama. Some filatures pack the books into a bale of 1 Picul in wrapping paper and high grade double matting.

COSTS OF PRODUCTION.

An analysis of cost of production in 1929 from enquiries in various concerns for producing 1 Picul of silk is given below. The price of silk per Picul then was Y. 1,400.00.

(1) Cocoon drying, transport and drying 160 Kwan of cocoons required to produce 1 Picul of silk, rendita being 10.)	- Y. 28.00.
(2) Reeling charges - each reeler reeling 1.3 lbs. per day, 13/15 denier silk, at Y. 1.00 per reeling girl for 133 lbs.	Y. 100.00.
(3) Re-reeling charges.	- Y. 8.00.
(4) Supervision, etc.	- Y. 22.00.
(5) Boarding and lodging charges of reelers, etc.	- Y. 35.00.
(6) Fuel, water, etc.	- Y. 40.00.
(7) Broker's Commission at 1.5 % on Y. 1,400.00.	- Y. 21.00.
(8) Packing and shipping charges.	- Y. 6.00.
(9) Miscellaneous expenses, such as insurance, taxes, etc.	- Y. 30.00.
(10) Interest on money for financing purchases, etc. for a period of 6 months at 10 % on an average, on Y. 1,000.00.	- Y. 50.00.
T o t a l.	- Y. 340.00.
Deduct:- Cost of Chrysalis - 1½ Picul at Y. 5.00 per Picul.	= Y. 7.50.
Double and waste cocoons.	= Y. 6.00.
Long waste - 1/6 of Picul at Y. 150.00 per Picul.	- Y. 25.00.
Pellets, etc.	- Y. 2.00.
	Y. 40.50.
Or	Y. 40.00.

Deducting Y. 40.00 from gross manufacturing charges of Y. 340.00 per Picul, the net manufacturing charges were Y. 300.00 in 1929 Spring. Since then, silk industry has experienced changes. It is difficult to give accurate

costs

costs of production now. Cocoon costs for 160 Kwan (This would give 1 Picul of silk) at Y. 6.25 per Kwan were Y. 1,000.00. This means that raw material cost 75 % of the total cost of production.

Tests in Filature. - Sizing tests are quite a routine. Elasticity and tenacity tests are not so common. In advanced filatures like Gunze and Katakura, elongation, elasticity, and tenacity are determined by Scott's Serigraph. ~~Serigraph~~. Seriplane tests are becoming quite common in filatures, as evenness is the most important test now-a-days done. For lustre, colour, etc., silk is inspected in dark rooms. Reelers are more often fined for bad and uneven reeling than rewarded for good reeling. Filatures have their own graduated scales of bonuses and fines.

H o u s i n g. - Filatures are housed in ordinary Japanese style wooden sheds. A few filatures are contemplating putting ferro-concrete buildings. There are roof-gable windows. Both sides of the longitudinal walls are well provided with full size glass windows. Even though the sheds are simple all hygienic arrangements are well looked after. The reeling basins are always well lighted. This is possible as the Japanese reels are not encased. 70 % of workers reside in filature boarding house. A room of 15' x 12' is given for 4 to 5 girls to live together, ordinary Japanese ward robes being given for each room. Bedding is also supplied by the factory. There is a common mess room. Meals are provided three times a day. The average charges on meals per month are about Y. 8 to 10 per head. This is borne by the factory. In well organised filatures, lodging and boarding arrangements are perfect. In Gunze Filature which is the model factory in Japan dining hall is common for 800 girls, 4 girls having one table. Food is hygienic, and according to Japanese tastes is better than what girls themselves could afford to. There is a Music School, and a school for continuation classes for education of girls. There are recreation

grounds

grounds. Hospital and well kept sick rooms are also provided for. In fact, there is nothing in this filature which is not model. In other filatures, arrangements are not as good as in Gunze, but not much fault is to be found with. 30 % of the workers live outside filature.

FACTORY LAW.

Recent Factory Law admits of ten hours of work only. But, in filatures actually eleven hours of work is taken. Work commences at 6 A.M. and continues till 6 P.M., with an interval of one hour between 12 noon and 1 P.M., and with 2 intervals of 15 minutes each, at 9 A.M. and 4 P.M.

Age, etc. of Reelers. - Average age is between 18 to 21 years. Girls below 16 years do not enter filatures. 60 % of reelers stay less than three years. 40 % stay over three years. In rare cases, they stay ten to twelve years. Absence due to illness on an average is 9 days per annum, and due to other causes, 19 days. Average daily production per day is one lb., the highest is 2½ lbs. and the lowest is 1/3 lb. On an average an ordinary reeler earns Y. 209.00 per year. Y. 580.00 is the highest, and Y. 44.00 is the lowest.

Training of reelers. - All filatures maintain an educational section for training reelers. The actual period of training varies between 3 to 4 months. During the training period inferior grade cocoons are given for reeling. Once or twice a week theoretical classes are also held to explain the various methods of reeling, care to be taken in reeling, inter-relation of several factors, etc., by one of the supervisors. The Experimental Station women assist experts, to go about the filature and demonstrate various actual operations. After the training is over, these girls are attached as apprentices to good reelers, then given independent work to reel 20/22 denier silk, and finally asked to reel 13/15 denier. There is an intelligent appreciation

on

on the part of reelers of all the processes of work, and of the important and loyal part they have to play in the Silk Industry. There have been practically no strikes in filatures. Training in cooking is also given. Some of them specialise in cooking.

SILK MARKET.

There are two markets for export of silk in Japan, viz., Yokohama and Kobe. There are about 30 active exporting firms in Yokohama, and in Kobe, about ten. At Yokohama about half of them are foreign exporters. They buy their silk mostly through silk brokers called "Tonya", who are licensed brokers of the Silk Exchange at Yokohama or Kobe. When an exporter buys through "Tonya" or broker, he asks for specifications regarding price, grade, quantity, and delivery, etc. The sales may be 'Spot' or futures. The futures are but few. The 'Futures' contract specifies(11 details and dates of delivery. The "Tonya" charges a commission of 1.5 % for his services, to the filatures. There is a Union of Brokers in Yokohama which sets down rules of practice in dealings, etc. for brokers. All the brokers are its members. Deliveries are made every five days and are not less than in units of ten bales (1 bale = 133 lbs.) In such a case, prices are fixed every fifth day, i.e., 1st, 5th, 10th, 15th, etc. of the month. This is done by a Committee of brokers and exporters. The panel of the Committee changes on every price fixing day. Prices for silk are fixed taking into consideration New York Stock Market reports, rate of exchange, stocks on hand, mulberry and cocoon crop reports, and such other factors that affect silk prices. The silk whose transaction has been agreed upon is sent over to exporters, or deposited in the Imperial Store House Company. Some exporters have their own fire-proof, etc. godowns. Fifty skeins are taken out from a lot of ten bales and seriplane, winding and other tests are carried on by the testing branch of the

exporting

exporting firm. Visual tests are also carried on in northern sky-light rooms. After the testing branch approves of the quality, the books are all put into a "Skirt" and bales prepared for shipment. Should the silk prove below the specification, the broker is asked to remove the lot, or a new transaction is effected if both sides agree to a settlement. The total arrivals in Yokohama and Kobe annually, are about 9 lakhs of boxes (one box = 74.4 lbs.), of which sales for export are about 8¼ lakhs of boxes, and about 25 to 30 thousand boxes are for local consumption.

Transactions in Yokohama are 80 %, while in Kobe about 20% of the total transactions are done.

SILK EXCHANGES.

There are two Silk Exchanges in Japan, one at Yokohama (established in 1894), and the other at Kobe (established in 1928). The objects of these Exchanges are to establish an exchange market for transactions of raw silk. The silk exchanges are but one branch of the general exchange for rice, stocks and shares. There are thirty-six brokers on the Yokohama Silk Exchange, and at Kobe fifteen. Each broker at Yokohama deposits a cash security of Y. 40,000.00, while at Kobe, it is Y. 30,000.00. The brokers are all big businessmen of long standing actually engaged in silk business.

There are two sessions and four calls a day.

First Session - First Call - 9-20 A.M.

- do - Second Call - 11-20 A.M.

After-noon Session- First Call - 1-20 P.M.

- do - Second Call. - 2-50 P.M.

At each call opening and closing transactions are done for six months, e.g., in November transactions, calls are opened and closed for December, January, February, March, and April.

Kobe Silk Exchange quotations on 5th July 1930, were:-

July.		August.		September.		October.		November.		December.	
Open-ing.	Clos-ing.	Open-ing.	Clos-ing.	Open-ing.	Clos-ing.	Open-ing.	Clos-ing.	Open-ing.	Clos-ing.	Open-ing.	Clos-ing.
Sen.	Sen.	Sen.	Sen.	Sen.	Sen.	Sen.	Sen.	Sen.	Sen.	Sen.	Sen.
60.00	64.00	60.00	50.00	50.00	50.00	60.00	50.00	60.00	50.00	55.00	50.00

The

The quotations are for 10 Kin (1 Kin = 1.33 lbs.) in ten Sen. To prevent gambling, the Silk Exchange puts a limit to variation in quotations. The limit is Y. 200.00 per Picul.

The first three days of the year and the last three days, the Exchange is closed. It is closed on National and other Gazetted Holidays also.

BUYING AND SELLING.

All transactions (buying and selling) are by competetive bids. Offers and bids are closed and are approved by the Exchange by indications of fingers and hands, and clappers. The transactions are all done on the basis of D. grade silk with an average seriplane value of 75 % or over. Actual deliveries against transaction are about 5 % of the total, done on the Exchange. The inspection on the Silk Exchange is very strict. Only 70 % of the total bales submitted are approved.

Through the Exchange the broker demands of his client to fill in margins which are of different kinds. Margins may be in cash or approved securities. Initial margin to the extent of about 50 % is required to be deposited when sales or purchases are to be effected. When the market goes against the client to the extent of more than half of the deposited margin, then the client is required to deposit a supplementary margin. Half of this must be in cash. Additional margins are called for when the market is in violent fluctuations. This is to be both from buyers and sellers, and one half of additional margin should strictly be cash.

Broker's Commission. - This varies according to price of silk for ten Kin and according to period to which contract relates. This varies from Y. 0.35 to 0.85 Yen according as the price of silk is Y. 90.00 or Y. 210.00 per 10 Kin. This is for a period of three months. Cheaper rates of commission are charged for near months. The commission

commission covers charges for opening contracts, or cancelling them by buying back or selling out.

Delivery against future contracts. - A future contract is fulfilled by actual delivery of raw silk and receiving payment. Or the contract may be cancelled by buying it back, or selling out. In the latter case the difference in price should be paid or received according as the case is. Delivery is admitted either at the Exchange, or one of the two approved Store Houses. Delivery is made on the date of delivery agreed upon between seller and buyer. Visual inspection of silk is made by the Exchange, and mechanical tests for grading are made by the Conditioning House. A fees of Y. 18.00 is charged for a lot of 10 bales (i.e., 1,333 lbs.) and an additional Y. 10.00 is charged for "Conditioned weight." When a delivery of non-certified silk takes place the seller has to pay the buyer a penalty of Y. 100.00 per lot of ten bales (i.e., 1,333 lbs.). The seal of certified silk must be in tact. Delivery should be made in 1,000 Kin (i.e., 1,333 lbs.), or in multiples thereof, but, an excess of 20, or deficiency of 30 Kin is permissible. In case of a greater variation than the above, the seller must compensate within 3 days of the date of delivery.

G r a d i n g. - This is in accordance with the Conditioning House Certification which will be mentioned later on. For the present it is enough to give the following table that indicates the grading:-

	13/15 Denier (White).						20/22 Denier.	
G r a d e.	A.	B.	C.	D.	E.	F.	W(White).	Y(Yellow.)
Average value not under	87.	84.	80.	75.	70.	65.	80.	80.
Average Denier	13.70	14.50	13.60	14.50	13.50	14.50.	20.50.	21.50.
Winding - Maximum number of breaks.	5.	5.	6.	6.	7.	7.	4.	4.

Average value is got by results of tests for evenness, size deviation, and cleanness, whose relative importance is 50 %,

25%, and 25 %, respectively. Since all transactions are based on D grade, a differential for prices of other grades is also necessary. This differential is fixed every year in January. But, when the differential varies much from actual transactions, the Exchange revises the differential to be as near the actuals as possible. The differential fixed in 1929 is given below:-

13/15 Denier White.	A.Grade	on Y. 50.00 (i.e., more than D.Grade
	B.Grade	on Y. 30.00.
	C.Grade.	on Y. 10.00.
	D =	Basis.
	E =	Off Y. 20.00.
	F =	" Y. 40.00.
20/22 Denier.	W =	Y. 150.00 less than basis.
	Y =	Y. 150.00 - do -

The Silk Exchange is a great factor in stabilising silk prices on the market, which have a great influence on cocoon markets. Its importance is felt in the raw silk industry considerably.

SILK CONDITIONING AND TESTS.

Law compels that all raw silk to be exported from Japan should be conditioned. There are two Conditioning Houses, one at Yokohama and the other at Kobe. The former belongs to Imperial Government and is a very old one. Kobe Conditioning House is Municipal, and was established in 1924. The Conditioning House at Yokohama is a ferro-concrete 4 storied, brick veneered building costing nearly fifty lakhs of Yen. The Kobe House is smaller. The first floor is reserved for receiving bales, and for finding gross and net weights of bales received. The remaining three stories are all used for conditioning, and other tests and for research laboratories and library. The work in both the houses is just the same. In Yokohama, research work is also carried on. There are two departments in each house, viz., Conditioning Department and Quality Test Department.

Conditioning Department. - In Yokohama there are 128 electrically

electrically heated ovens. Most of these are of Messrs. Kawanishi Manufacturing Company at Kobe. The ovens ~~are heated electrically and~~ can be kept at 130° to 140° constant. There is a side oven in which skeins of silk may undergo preliminary heating which cuts down time. To avoid handling of small weights a chain balance is provided for. Four ovens are connected together by a system of draft chimneys operated by an electrical fan. There is a basket by means of which skeins to be operated upon are hung loose. These ovens are as good, if not better than the Swiss make. The price ranges between Y. 800 to Y. 1,000.00. Silk is received in lots of ten bales. Gross and net weights are found out. From 4 bales (out of ten bales) 32 skeins, 8 from each bale are indiscriminately drawn out, separated into two divisions A and B and register number given and passed on to "Conditioning" Section. Four skeins are consigned in each ~~booklet~~ basket of the oven at 130° to 140°. One girl can attend to 4 dessicators at one time., The original and absolute weights are recorded, and skeins passed on to a skeining department where they are skeined and finally handed over to the owner. There are index books for finding out conditioned weight. In 30' one set of 4 dessicators can determine "Condition" weight of 1 lot of silk, i.e., of 10 bales. The capacity of Yokohama Conditioning House is for 2,000 bales a day. Should there be a difference in conditioned weight of over ½ % between A and B sections of the same lot a third test is repeated. The total number of conditioning tests carried at Yokohama in 1928 was ~~for~~ 42,593 representing 405,793 bales. The total conditioned weight was 25 million Kilos. Each bale is charged for Y. 1.00, i.e., a lot is charged for Y. 10.00. This charge is recovered in the form of stamp.

Quality Tests. - These tests are optional and are useful in indicating grade of silk, etc. which facilitates transactions and the tests having been done in a Government Institution are reliable.

Winding Test. - Though this is not the most important test

test, yet it is done first to facilitate operations. 50 skeins are taken at random from the 10 bale lot (from 4 bales), 25 are wound from out side, and 25 from in side for 1 hour, the speed being 150 metres per minute. The number of breaks is counted and due entries made.

Seriplane Test. - This is the most important quality test as it determines evenness, cleanness, and neatness which are so essential in weaving mills. In Japan, there are two tests called test A and test B. In America only B test is carried on.

B.Test. - On a Seriplane which is a black board of about 5' length, and of a total round of 1 metre, silk is wound from bobbins received from winding test branch. The seriplane winding machine has fine adjustments by means of a side gauge. Silk is wound uniformly, and can be adjusted according to denier. For instance 13/15 denier silk is wound 500 pieces, while 20/22 denier silk is wound 400 pieces on the panel. Each board has 10 panels. 100 panels are examined for determining the final average. This test is done by comparing the evenness of silk wound on the board with standard photographs under "Head light" in a dark room or a white room, the latter being the modern method. The average of the results of examination is mathematically worked out from entries. In calculating the average evenness, regard is had to penalty percentage also. The Seriplane B Test is an invention of Fredrick Schimitsa of Messrs. Chenai Brothers of United States of America.

Seriplane Test A. - After examining for test B and for cleanness and neatness tests, the seriplane boards are passed for test A. This is done for 100 panels. A hand serimeter is used for testing evenness in terms of tenacity which is directly recorded for each thread drawn out by the hand serimeter by a girl. Entries are made for such panels for which penalty is to be recorded. Penalty

is

is calculated by awarding points for low and high extremes for each kind of thread. The average of two panels is got and entered. One girl can do 100 panels in 10'.

Size Deviation. - From the bobbins 200 sizing skeins are wound, and sizes are recorded. Mean deviations and size deviations are calculated, and the total average size is always found out.

Cleanness and Neatness. - Panels are examined for cleanness and neatness for major and minor defects. Major defects are all ticked against with 2 points and minor defects with 1. Then average for each are calculated and entered.

Tenacity, Elongation. - Tenacity and elongation are found out from Scott's Serigraph for 200 sizing skeins, each time determining for 10 sizing skeins.

C o h e s i o n. - This is found out by the number of strokes necessary to just open the silk thread. The average number of strokes is got by recording the number of strokes in each case, then adding and dividing by the total number of samples under inspection.

A "Composite result" Table is prepared under various heads and percentage points are alloted by reference to a table. The composite percentage is found out and the grade of silk is determined. For grading the essentials are - Evenness Tests A and B, average low panels, cleanness, neatness, and size deviation. Winding, cohesion, tenacity, elongation, and average size tests are also recorded, but they are not taken into account for grading.

Visual Tests. - These are done both for the lot and individual books. For lot, only quality and finish is recorded. For books, quality, colour, lustre, and nature are recorded. These tests are also fairly elaborate.

Prefectural Conditioning Houses. - Besides the two Conditioning Houses at Yokohama and Kobe, there are small

Conditioning

Conditioning Houses in some prefectures, like Fukui, Ishikawa, and Kyoto, etc. for conditioning of silk for home consumption. The equipment and methods are the same. Only the latter houses are of a small magnitude. Fukui Prefecture has not only one Conditioning House at the head-quarters, but, has a few in counties to facilitate work. Fukui and Ishikawa are great weaving centres, and there is considerable transaction in raw silk. These test houses carry on not only conditioning, but also quality tests. The existence of these prefectural houses ensures fairness in trade, indicates importance paid to quality in manufacture of cloth.

The number of evenness tests carried on in Yokohama is about 1,500 under test A, and about 30,000 under test B. Besides, special tests to the extent of 15 thousand are conducted. It is seen that the number of B tests that was over a lakh in 1922 has fallen down gradually to 30,000. This is due to the fact that exporters are having their own quality test departments.

Even with the large number of tests that are carried out, the American consumers contend that the number of tests is so small that the averages got cannot be safely replied on. Against this, Japanese have proved by working on theory of probability of error that the number of tests as carried by them is quite sufficient. Final decisions have not been arrived at. After all, America is consumer and Japan may have to yield at least in some respects.

Classification of Silk. -

14 Denier. -

National.	A.	B.	C.	D.	E.	F.	White 21 Denier W	X.	Yellow 21 Denier Y.	Z.
New -York.	Superior Grand××	Grand××	Special Crack××	Crack××	XX	Best×	Grand××	Special Crack××	Grand××	Superior Classical××
Seriplane Test B %	Over 88	Over 85.6	81.2	77.8	75.6	Below 75	85.6	82.3	85.6	82.3
Cleanness %	Over 90	85-90	85.	80-85	75-80	Below 75.	90.	85.	90.	85.

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This is the classification agreed upon between Japan and America. Japanese grading is more scientific than European grading, as seriplane is indispensable in America and Japan, and that size deviation finds a very important position.

HAND AND FOOT-REELING.

Besides reeling in filature, there are still as many as 62,088 hand or foot-reel establishments. The total number of basins is 85,363, producing about 40 lakhs of pounds of silk annually. The hand reel is a simple machine. It is worked by one hand, and the reeler uses the other hand for reeling. The cocoons used for reeling are very low grade ones. The foot-reels have a foot pedal for conveying motion to reel. The reeler works in both hands, and uses buttons, and the croissuer is good. Cocoons of not bad quality are used. Both of these are cottage industries. Generally, the raiyats reel their own silk, or sometimes low grade cocoons may be purchased and reeled. The total quantity of waste produced is about 13 lakhs of pounds. Out of this, about 60 % is good long-waste called "Kibisso." ~~This~~ The silk is mostly for home consumption. Some quantity is exported to India, but, it is negligible. Prices of this silk depend upon market prices of filature silk, and cocoon market. Generally, its price varies between 65 to 70 % of the filature silk.

DOUPION SILK.

Japan rears univoltines and bivoltines, and the percentage of double cocoons is between 9 to 10. Annually about 7 crores of pounds of double cocoons are produced. When the price of ordinary cocoons was Y. 6.00 per Kwan, double cocoons were sold at Y. 2.50 to Y. 3.00. The total number of double cocoon reeling establishments is about 10,000, with 31,832 basins, and with a total production of about 55 lakhs of pounds of silk. An appreciable quantity of the silk is imported into India, and competes with Mysore Silk. The quantities of import of this article are gradually on the increase. Its price is generally 50 % of filature silk

silk. Doupion silk compares very favourably with our charka silk in quality. Very little of modern machinery is employed in reeling doupion silk. Big establishments may have 50 to 300 basins in one filature. Some filatures use modern basins. In small establishments hand-reels are used. Cocoons are cooked for longer period. Generally, 25/26 denier silk is reeled. On an average a reeler gives 100 Momme of silk (i.e., 4/5 lb.) working 11 hours. The rendita is between 10-12. Reeler is paid for generally according to quantity of silk produced. On an average a reeler may get Y. 0.50 a day. The chief reeling centres are - Mae-bashi in Gumma Prefecture, and Toyohashi in Shizuoka Prefecture.

SILK WASTE & ITS UTILIZATION.

Total quantity of waste produced in Japan is about 3 crores of pounds, and is 33 % of the total quantity of silk. Of this, 85 % is filature waste, and the rest is from hand-reel, foot-reel, and doupion establishments. In wastes, the following are included in Japan. - Prices quoted are all for Spring Season. - (1930).

(1) Degara:- These are pierced cocoons and cost about Y. 300.00 per Picul of 133 lbs.

(2) Agari Mayu. - These are unreelable cocoons in the reeling basin. These form about 2 %. Cost - Y. 100.00 per Picul.

(3) Kibisso. -This class includes long waste, and other wastes got in reeling, and brush waste also. Costs vary from Y. 150 to Y. 300.00 per Picul.

(4) B i s u.- This is got by collecting thin layer of silk over pupa. Very poor grade waste. Cost - Y. 70.00 per Picul.

(5) Kirigara.-Cocoons cut in filatures, etc. during quality examination. Cost is Y. 300.00 per Picul.

(6) K a b a. -French - Bourrease. Floss converted into noils. It forms 1 % of the total waste. Costs Y. 400.00 per Picul.

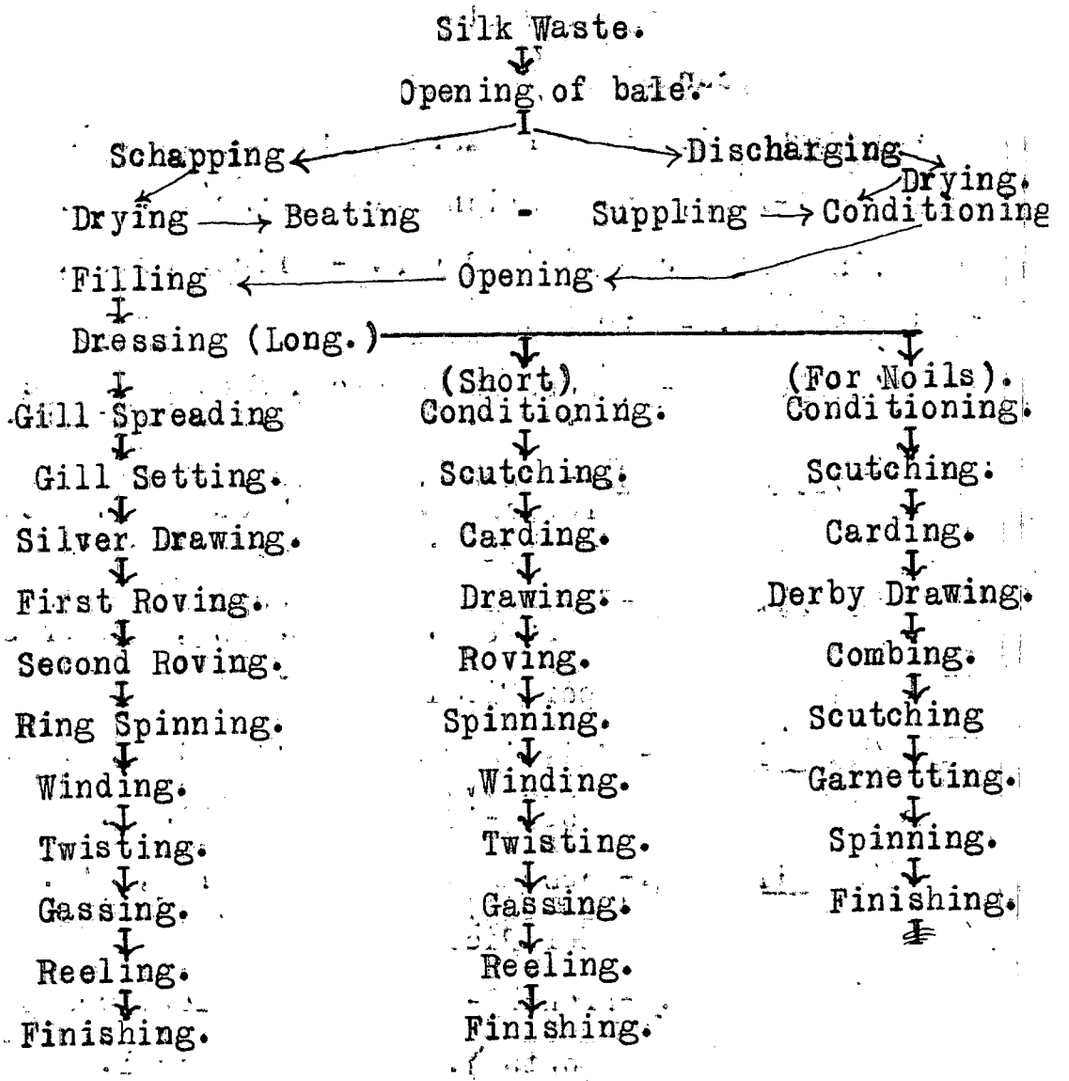
(7) Kuzu-ito.-This is waste silk got in re-reeling. This forms 1 % of the total quantity of raw silk. Costs about Y. 400.00 per Picul.

The prices given above are relative. Since Spring there has been considerable decline in prices of silk-waste.

Now

Now-a-days, about 80 % of the total quantity of Japanese silk waste is consumed in Japan, and about 20 % is exported. There are altogether 360,000 spindles in silk waste spinning establishments.

Manufacturing. - As a rule high grade wastes are used separately from low grade ones. In some factories there is mixing of ordinary and low grade raw materials. Of the two methods of first treatment "Schapping" is very little done. Scouring and discharging are commonly practised. Schapping is avoided mainly because, that in inoculating bacteria there is always of other bacteria than fermentation bacteria also find place in Schapping pots. Where Schapping is done pots used are of small size. Below is given a table of operations. -



After opening bales, material is opened, and dirt, etc. is removed. Then, follow the process as per above table according as the material is noils, long, or short drafts.

Schapping. - This is done in porcelain pots of 2' diameter, and of 2 feet in height. The material is allowed to

to ferment for 3 days at 35°C. Soda and Marseilles Soap are used. Pots outside are surrounded by hot water jackets.

Discharging. - This is done in copper cauldron which contains hot water, and steam is heated. About 200 lbs. of waste is put, water added, and weak boiled for one hour, adding 5% of Marseilles Soap, 2% of soda. The material is taken out and washed in cement tanks and submitted to another boiling with 10% of Marseilles Soap and 1% of soda. Next it is washed in cement tank, and again in washing machine till soapy feel is completely removed. Water is completely wrinsed out by hydro-extractor. The material is now dried in a room at 85°-90°C. After the material dries, it is spread out evenly, and soap solution (15%, variable) is sprayed till proper condition is obtained. For each subsequent operation there are engines to which the material is subjected as in spinning cotton. But, there are differences between cotton and silk-waste spinning. The needles and porcupines on several engines differ.

200 lbs. of Japanese long waste after discharging and drying reduces itself to about 140 lbs. After "Conditioning" it becomes 165 lbs. Subsequent to conditioning in 'Opening', 'Filling', and 'Dressing', it reduces to 100 lbs. Again it loses about 2 lbs. in picking, gill spreading, setting, drawing, roving, and spinning. After doubling, twisting, and gassing, it reduces to 90 lbs.

ERECTION OF FACTORY.

The main engine on which calculations are made in erecting a factory is spinning frame. Each spinning frame has 300 spindles and can produce in 8 hours 15 lbs. of 135 count yarn. Assuming 200 lbs. production of yarn per day for a factory to work on commercial lines, the following would be the requisites:-

1. Opening engines 2 - Can handle 400 lbs. of waste.
2. Ordinary Filling engines. 3. - Can handle material from 2 opening engines.
3. Small filling engines 5. - Each can handle about ⅓ the material from No. 2 Circular

4. Circular Draft Engines	-10	- Each handles ½ of the material from a single small filling engine.
5. Gill Spreaders.	-	8. - The number of this is less than circular draft engine.
6. Gill Sett Frame.	-	4. - ½ that number.
7. Drawing machines.	-	5.

But adjustments in working would be possible if double shifts are arranged for some processes.

A temperature and humidity regulating apparatus would also be necessary. Besides the boiler for use in 'Discharging' operation, water supply and motor power for driving the several engines as necessary.

The erection of a silk-waste spinning factory in Mysore deserves sympathetic consideration.

SILK WASTE TRADE.

Fectories and exporters purchase through brokers in Yokohama and other centres. There is no scientific grading of silk-waste. Japanese waste may be said to be good in as much as bad practices are but few. Some of the biggest manufacturing firms are Messrs. Kanegafuchi, Messrs. Fuji Gasu Boseki, and Messrs. Showa Mills. An appreciable quantity of silk waste yarn is being imported into India. Messrs. Mitsui are agents to some of the above big companies.

The recent report of Messrs. Osaka Kikai from Japan on the behaviour of our silk wastes in actual operation is very encouraging.

ARTIFICIAL SILK.

A careful survey of world's production of natural silk and also of artificial silk indicates that the production of natural silk has in no way suffered. It is true the phenomenal rise in manufacture of artificial silk has directly influenced prices of raw silk to an appreciable degree.

There are several processes by which artificial silk is manufactured, viz., Viscose, Cellulose-acetate, Nitro-Cellulose

Nitro-Cellulose, Cupro-Ammonia, and Chardonette. Viscose is the cheapest, but the quality of artificial silk is not so good. Cupro-Ammonia process gives good quality artificial silk. Chardonette is very costly, as considerable quantities of ether and alcohol are used. England employs both Viscose and Cellulose acetate; Nitro-cellulose process is employed largely in Belgium and America; Germany has Cupro-Ammonium process. In Japan, it is practically all Viscose. There is no admission to factories. Uyeda College, where I worked for silk-waste spinning, and for manufacture of artificial silk, is the only place where one can see the processes.

Manufacture of Artificial Silk by Viscose Process:-

Caustic Soda ~~Bye~~ lye of 15 degree strength is filled in iron tanks kept at a height of about 10' from the ground level. The tanks are maintained at 18° to 20° C, and have temperature regulators. From these tanks Soda ~~Bye~~ lye is discharged by means of a pipe to an iron tank containing a cage which holds wood pulp in the form of pressed boards. These boards are just covered with soda lye and allowed to remain for 2 hours. The soda lye from boards is now pressed out by means of a press, and the pressed out soda lye is transferred to a mixing tank kept under the supply tank to which it returns. From the pressed condition, the material is transferred to a "Kneading machine" worked by power by means of a shaft. The material is here crushed and powdered. This substance is transferred to a 'Ripening box' (Alkali - Cellulose), and is spread for three days at a constant temperature of 18° to 20° C. This ripened alkali-cellulose is transferred to a "Sulphidizing" chamber, where carbon-di-sulphide is added at the rate of 35 to 40 grammes per 100 grammes of dried cellulose (or 310 grammes of pressed alkali-cellulose.) The whole is now churned for 2 hours at 22 to 30° C. (At the beginning the temperature is 22° C and gradually it rises to 30° C due to chemical action.) The substance now assumes colour of the yolk of egg. This

is

is xanthate which is transferred to dissolving machine containing 17 % Na OH solution. The solution made contains 8 % of cellulose, 7 % of Na OH, and 85 % water. This is calculated each time. This dissolving machine is connected with a cooling apparatus for constant temperature of 16° to 18° C. Dissolving continues for 4 hours, and very large power is required for this operation. The material is now submitted to 'After ripening' process. It is sent to pressure tanks from which it is pressed into filter press from where it is pressed to 'Spinning tank' with compressed air. The fluid is forced through 'filtering candles' having glass tubes which have spinneretes attached to it. The filaments as they come out coagulate in a bath containing 10 % H2 S04, 5% Glucose, glauber's salt (300 grammes per litre), and zinc sulphate at the rate of 70 grammes per litre. The tube dips into the bath, the thread floats. This is picked, passed over a guide, and then to glass funnel, and then into centrifuge boxes rotating at 5,000 to 6,000 revolutions per minute. The spinning velocity is 40 to 45 metres per minute. In making 150 denier artificial silk centrifuges are removed every 70' -80', and contents discharged and reeled into hanks.

The sulphuric acid bath is absolutely necessary and is kept at 40° C in constant circulation. The hanks are washed under water spray for 24 hours, then dried in shade, stretched in a stretching machine, and desulphurized with Na2 S (1% solution) for 30' at 60°F. They are again washed with water at 20°-30° C, bleached with sodium hypochloride solution (strength of active chlorine being 0.7% to 1%) for 20', and again washed with water. They are treated with Hydrochloric acid of 1.5 to 2% strength for 20', washed, treated with Marseilles Soap, or Olive Oil emulsion. During this process hanks are hung on 'ebonite' pegs. After oiling, hanks are submitted to hydro-extractor. The denier depends upon speed of delivery, and viscocity of solution. The most important manufacturers of artificial silk in Japan are:-

Messrs.

1. Messrs. Nippon Rayon & Co. - This factory has a capacity of 6,000 to 7,000 Kilos per day.

2. Messrs. Teikoku Jinzo Kabushi Ki-Kaisha.

3. Messrs. Toyo Rayon and Co.

Prices ranged between Y. 1.30 to 3.50 for artificial silk of 250 denier to 60 denier in May.

A large quantity of artificial silk and its products are imported into India from Japan.

WILD SILK Worms

There are two kinds of wild silk-worms that are raised in Japan. Antherea Yamamayi, and Antherea Pernyi, the local names being Tensan, and Sakusan, respectively. The former is chlorophyl green in colour, and the latter is brown resembling tassar in several respects. Tensan is reared on Quercus serrata, (Japanese name being Kunugi Nara.) Sakusan can be reared on Quercus Serrata, Quercus Mongolica, or Quercus dentata. These are reared in hilly districts, largely in Nagano, and Ibaragi prefectures. Quercus Serrata is cultivated by raising seedlings and planted in roughly prepared ~~planted~~ land at 6' x 6' during spring. Bushes are allowed to grow between 4' to 6' only. Every year there is pruning done between December and March. The crop is available three years after planting. The total area under cultivated oak is about 1,300 acres and that mostly in one county of Nagano prefecture. The total quantity of Tensan and Sakusan cocoons in 1918 was about 12 millions, which fell to 5 millions in 1921 and rose to 12 millions in 1929. Of this, 33% were Tensan and the rest Sakusan. The fall was due to pebrine and fly pest. Pebrine is now controlled by examining female moths in the local inspection station. 100 cocoons give 7 Momme of silk, i.e., it takes about 1,800 cocoons to produce one pound of silk. In one acre, one can get only about 8,000 cocoons or just as much as to produce only 4½ lbs. of silk. The total value of silk of Tensan is about Y. 92,000.00 and that of Sakusan Y. 60,000.00.

(Tensan)

It is a univoltine and is reared in spring. Eggs pasted

pasted on strips of paper are tied to branches of the plant. Young worms hatch and feed at "Vira." Generally, eggs are tied about the 10th of May to the branches of the oak bush. The larval stage lasts for 50 days. The pupal stage takes 7 to 10 days, and another 7 to 10 days for moths to cut out if cocoons are preserved for seed purposes. Cocoons for seed are arranged ~~for seed~~ with "Ends on" for moths to emerge. One female and one or two males are let in a conical bamboo basket with wide meshes and the open end is closed by means of paper and string. The pairing lasts from evening to evening when eggs are laid. The seed baskets are hung up in rows in an open shed and kept till the season comes in. After the moths die males are thrown away and females are removed, numbered, etc. for examination. In early spring, eggs are scraped, washed and subjected to a temperature of 40° F for 20 days, removed, pasted on papers and tied to branches of oak bushes. They hatch in ten days afterwards.

Seed cocoons cost Y. 0.03 and reeling cocoons Y. 0.015 each.

Reeling is done without any preliminary cooking. Ordinary basins are used. One reeler can produce 50 to 70 grammes of silk a day. The price of silk in 1929 spring, was Y. 52.00 per lb.

This silk is used largely for ornamental designs especially in the broad waist band (Obi) for women in Japan.

Antherea Pernyi is a bivoltine, i.e., it gives summer and autumn crops. The treatment is similar in several respects to that given for A. Yamamayi. A large quantity of silk of A. Pernyi is imported into Japan from Manchuria and Shantung. This silk is cheap. Experiments are being successfully conducted on feeding A. Yamamayi and A. Pernyi on Silver Oak in Manchuria by the Experimental Stations of South Manchuria Railway Company.

Silk

SILK WEAVING.

Silk is woven for export as well as for home consumption. Fukui, Ishikawa, Gumma, and Kyoto prefectures are noted for silk-weaving of various silk cloths, such as Georgettes, Crepes, Plains, and in fact all sorts of manufactures. Mostly the mills are small factories of 10 to 20 looms. In Fukui and Ishikawa, 200 to 300 looms in a factory is not uncommon. Power looms worked by electricity are the rule. Some factories have automatic looms. In small factories twisting, doubling, and dyeing are done in the primitive machiney. In bigger factories twisting and doubling plants are not uncommon. Or in centres like Fukui, and Kanazawa large throwing mills are worked by joint stock companies and orders from mills are executed, or the throwing mill may purchase silk, twist and double and sell the thrown silk. The Nippon Throwing Company at Kiriyu (a big weaving centre) with 43,000 spindles, is the biggest throwing mill in Japan. White thrown silk of this mill is exported to Benares. 5 H.P. is used for operating 1,000 spindles. (Electric energy costs 5 Sen = annas 1¼ per Kilo Watt.) For degumming, 1 % Marseilles soap and 1 % Olive Oil is used. Throwing machiney is manufactured in Kiriyu, but the Italian one is better made.

A typical small scale factory of Mr. Morishima which I saw and where I made a detailed study, has 7 power looms. It weaves mostly "Chirimin" (Crepe). The Horse Power used is only 2. He has a small spooling machine of 10 spools and a winding machine of 50 spools. Twisting is done on ordinary drum wheel. In throwing branch, 13 girls work, and in weaving shed, 3 girls. Each loom gives 22 yards of "Chirimin" a day of 10 hours. His total annual production is 4,000 pieces, each piece selling at Y. 20.00. Degumming and dyeing are done in his own factory. To his Co-operative Society for tests, etc., he pays Y. 0.80 a piece.

His

Net income after allowing for depreciation and other charges is Y. 2,000.00 a year. This factory may be taken as an average type.

Silks manufactured in Japan are exported to several countries of the world. India imports a very large quantity of plain silks, as well as prints, crepes, etc.

All silk piece goods to be exported have to be examined and certified exportable by Cloth Inspection Station; either Imperial or Prefectural, whichever happens to be in the jurisdiction. There is a guild for factory owners. This maintains a Test House for piece goods to be consumed in Japan. The tests conducted are yardage weight, surface defects, and number of warp and weft defects. Silk weaving industry is a very flourishing one in Japan. There is an Association of Indian Silk (Piece Goods) Merchants' Association at Kobe. Its objects are to safe-guard their trade, to get examination made of piece goods, to settle disputes that may arise, to promulgate methods for transacting business, etc.

SERICULTURAL LAWS.

The most important Laws in existence are the Sericultural Law, and the Regulations for the application of Sericultural Law, Regulations relative to Inspection Stations. The essence of these Laws is to see that diseases of silk-worms are kept under control, and that seed production is supervised and licensed. The translations of several laws will be submitted separately.

NATIONAL SUBSIDIES.

The State contributes towards expenses on various items of expenditure. The National help for prevention of silk-worm diseases is Y. 173,000 annually. The prefectures spend nearly 2½ Million Yens. To improve mulberry cultivation State aids to the extent of Y. 22,000, while prefectures spend Y. 611,000 annually

annually. Towards manufacture of original eggs of silk-worms the Imperial Treasury contributes Y. 37,000, and prefectures spend nearly Y. 2,000,000. The Raw Silk Association of Japan is helped to the extent of Y. 13,000 by the National Treasury. For investigating and remedying the existing defects State aids to the extent of Y. 1,005.00 to each prefecture, and an additional Y. 1,000.00 is given for investigating certain appointed things. In times of depression the reeling industry is given "Subvention" on a large scale just as this year, Y. 3,000,000 were given to stabilize raw silk prices. On the whole the contributions are generous, and given in a way such that the industry or its organization is affected to an appreciable extent.

FUTURE OF THE SILK INDUSTRY.

Artificial silk has been replacing cotton, and to a certain extent has been responsible in bringing down prices of silk. Rayon may even improve further. China is becoming a serious competetor in International silk markets. The future of silk industry lies in improving quality, and cheaping costs, and giving satisfaction to the customers.

C O N C L U S I O N.

The essential features of organization of silk industry are that ~~it~~ the organization is universal and efficient. The silk-worm diseases are controlled by examining all seed to be used. The seed makers are all licensed, and well under control of the Government Institutions under Law. Great attention is paid to Sericultural Education to man all Government Institutions, filatures, etc. A large number of trained men from prefectural sericultural and agricultural schools settle down in life as sericulturists. This enables sericultural work to be scientific and rational. The guilds exist separately for each branch of work and appreciable advantage is taken by members of the existence of such institutions. There is a real spirit of co-operation which is strengthened by a live national instinct to compete successfully against other

untries. The research work done in improvement of
f silk-worms, evolving of new races, and also of
ry, better methods of rearing of silk-worms, and culti-
on of mulberry, and attention paid to improvement in
ling are potent factors in the rapid development of silk
ndustry. The artificial hatching and standardized cold
storages for use of summer and autumn crops has materially
added to the out-put of cocoons and consequently increased
profits to rearers and reelers. Exact, accurate, and timely
statistics have considerably facilitated work of forecasting
crop values, ~~and eventual disposal~~. Added to the several
factors cited above, the spirit of progress in all directions
keeps a healthy atmosphere, as otherwise stagnation would
set in. The spirit of team work and co-operation on the
part of workers in all institutions has undoubtedly done much
in solving new problems, and carrying through ordinary work
very successfully which otherwise would be very difficult
to accomplish. The raiyat on his part has by working hand
in hand with the institutions created facilities. The Govern-
ment have always been generous in responding to all calls
from those engaged in sericulture, besides taking initiative
themselves in many respects. Above all the Imperial
solicitude for the advance of the industry keeps a stimulus
in every one. This imperial patronage has taken practical
shape in actually rearing worms in the Imperial Palace
and in raising mulberry nurseries, and this is undoubtedly
a dynamic national factor in the life of the sericulturist.

D 4

K. Shama Rao

Mysore,
Dated 25th Novr.1930.

Assistant Superintendent of Sericulture
(On Special Duty.)

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A BRIEF REPORT

ON THE

SERICULTURAL INDUSTRY AND ITS ORGANIZATION IN JAPAN

A BRIEF REPORT ON THE SERICULTURAL INDUSTRY AND ITS ORGANISATION IN JAPAN.

Introductory.

The total area of Japanese Islands is about 133,000 square miles (exclusive of Korea, etc.). The country may be termed mountainous. Plains occupy an area of about 10 per cent. The Kwanto plain is the biggest, having a population of ten millions. Next to this are Nobi, Kinai, Echigo, Sendai and Kitami plains. These latter plains also support a population of about ten millions. These plains are fertile, and are very important sericulturally.

The climate of Japan is influenced by periodical monsoons, *viz.*, summer and winter ones. Japan is cold for its latitude and is "wet." There is considerable difference between temperatures of north, middle, and south. In January, in the north, the mean daily temperature is 0·3°C., while in the middle it is 8·2°C., and in the south, it is as high as 11·9°C. In June, the corresponding temperatures are 18·3°C., 24·5°C., and 26·1°C. This has an important bearing on the sericultural operations of each Province. Even in the same latitudes there are considerable differences in the climate according to mountainous and plain countries.

There is considerable snow-fall in the winter in northern district, while in the middle regions, the snow-fall is appreciable, and in the south, it is almost nothing. On the Pacific Coast it is less, and on the Western Coast it is comparatively more. Therefore, in the northern and sub-northern portions of the island, mulberry is either "middle," or "tree" system, while in the central and southern regions it is almost entirely "bush" system.

Rain-Fall.

All over Japan rain-fall is evenly distributed throughout the year favouring agricultural operations. This factor is *very important in Sericultural Economics* as mulberry is cultivated without expenditure on irrigation. This cuts down costs of production of raw silk considerably. The annual average rain-fall in the south varies according to places from 80″ to 100″, in the middle and sub-middle districts it varies from 65″ to 85″, and in the north it varies from 60″ to 80″.

Humidity.

Japan's geographical position is responsible for its humid condition. The annual average percentage of humidity in the south is 79, in the central regions, it is 74 and in the northern region it is 80. In the south, rainy days are 167 per year, in the central 139, and in the extreme north 192.

Sunny days in Japan are few. On an average 150 days are rainy or snowy and the remaining sunny or cloudy.

Frost.

Frost often affects mulberry in Japan. It generally occurs between the 12th of April and 16th of May according to situation of district. It is almost regular for the same locality year in and year out.

Population.

The total population of Japan Proper is about six crores. The rate of increase in the last five years was 6·7 per cent or an average increase of seven lakhs and a half per year. The density of population is 410 per square mile. The ratio of males to females is 101 to 100. Urban population is 14·8 per cent, while the rest is rural. Agriculture is the main occupation of the rural population.

Administration, Etc.

Japan is a Constitutional Monarchy. It embodies the cult of Imperial ancestor. The Emperor is advised by a Privy Council, and in times of emergencies, he consults and acts on the advice of "Genro" or elder Statesmen, so named by him. There is a House of Peers and a Lower House, corresponding to House of Lords and House of Commons, respectively, in England. The Lower House is elected, and the Prime Minister with his cabinet is responsible to the House. Each Minister has several departments in his charge. There are no direct departmental heads. The administration is carried on by the Ministry directly through the Governors of the Prefectures. Each department of the Ministry has a secretary to whom all papers are submitted by the Prefectural Governors. Japan Proper is divided into forty-seven prefectures. Each prefecture is in charge of a Governor who is directly the subordinate of the Home Minister, but is responsible to the several Ministers in the several departments. He has three assistants of the higher rank. One of them is the Vice-Governor, who has the charge of the administrative section, and development departments, such as agriculture, sericulture, etc.; while for education, there is a special officer, and for police, there is a police officer. Judiciary is independent. The Governor has a non-official Advisory Council. Sericulture is under the Ministry of Agriculture and Forestry, excepting the three sericultural colleges and several sericultural schools, which are under the Education Minister.

The Position of Sericultural Industry in Japan.

The total area of arable lands is 14,909,724 acres, being 16 per cent of the total area of lands. Paddy fields occupy 52 per cent of the total area of arable lands. Mulberry comes next to paddy in extent, being about 1,500,000 acres. It occupies one-tenth of the total arable land or one-fifth of land under paddy. The money equivalent of annual production of paddy is Y. 1,835,000,000, while that of raw silk is Y. 900,000,000, *i.e.*, 50 per cent of that of paddy. Thus, mulberry is of very great economic importance in agriculture, and has a great national value. Again, if trade figures are analysed, we find that out of a total export trade of about two billions and a half yen, raw silk and its products, etc., contribute nearly 40 per cent, *i.e.*, about nearly a billion yen annually. Without her raw silk trade, Japan would be nowhere in international commerce. It is this factor combined with its "cottage" aspect that has made Japan to devote full attention to the development of sericultural industry in all its aspects. Mysore, on a small scale, can hold the same position as there are several points of resemblances. Of late, in Japan, cotton textiles have shown a rapid advance, but, the existence of cotton textiles depends upon imports of foreign cotton. Whereas, silk industry is entirely a home one.

Position of Japan's Sericultural Industry in the World.

Out of a total production of 420,012,000 kgs. of cocoons, Japan produces 341,697,000 kgs., or nearly 80 per cent of the total output (leaving China out of account), while Italy is responsible for 50,000,000 kgs. or about 12 per cent of the total, and France, for 0·80 per cent. In 1927, the total output of the world of raw silk was 54,643 metric tons. Of this, Europe contributed 5,530 metric tons, while Asia was responsible for the rest, *viz.*, 49,113 metric tons,

Japan contributed 37,653 metric tons, while China was responsible for 9,675 metric tons. Italy, the premier silk producing country of Europe, was responsible for 4,627 tons. Japan, in 1927, produced 69 per cent of the world's output, and 84 per cent of her production was exported, 94 per cent of which was to the United States of America.

In 1915, the total output of world's raw silk was 29,300 metric tons. Japan contributed 14,080 metric tons, which increased to 37,653 metric tons in 1928, or, her (Japan's) production has been trebled, while that of the whole world has nearly doubled during the same period. In 1868, Japan produced only 20 lakhs of pounds of silk, in 1893 she produced nearly one crore of pounds, while in 1927, the total Japanese production rose to 7½ crores of pounds. This means that, within a period of sixty years, Japan's output increased by thirty-five times. This phenomenal growth is due to increase in mulberry acreage, rearing of summer and autumn crops, introduction of artificial hatching, improvement in silk-worm races, genetical work, improved methods of rearing silk-worms, better methods of reeling, scientific research, universal organisation, technical education, increase of raw silk exports, especially to the United States of America. In a word it is due to rationalisation of the sericultural industry in all its phases

Number of Farm Households, Etc.

The total number of farm households at the end of 1928 was 5,575,881, being 47 per cent of the total number of households in Japan. Of this, 71 per cent are engaged in agriculture alone, while the remaining are engaged in agriculture together with other occupations. Sericultural households at the end of 1928 were 2,165,265, showing an increase of 3 per cent over 1927 figures.

General Sericultural Statistics.

In 1918, the total area under mulberry was about 12½ lakhs of acres which gradually rose to 15 lakhs of acres in 1928, or an increase of 20 per cent in ten years. In 1922 the number of nursery owners of mulberry plants was 51,799 and in 1928 it rose to 199,183. During the same period, the total quantity of plants (including seedlings, graftings, root-suckers, layers, and others) increased from 223,863,951 to 555,042,238. The corresponding value was Y. 3,293,106 and Y. 4,644,925, respectively. In 1926, the number of plants used was as high as 924,000,000 with a total value of Y. 15,288.566. The above figures are indicative of the value set on good mulberry seedlings, etc.

In 1918 the number of seed-makers was 10,790, which fell down gradually to 7,195. During the same period, the total number of disease-free layings produced was 933,523,740 and 902,285,861, respectively. In 1918, the total number of "reproductive eggs" manufactured was about three crores of disease-free layings, while industrial eggs formed about 90 crores. In 1928 the quantity of "reproductive" eggs used was about 1 crore and 82 lakhs of disease-free layings and that of industrial eggs, 88 crores. It is seen that though the area under mulberry increased, the total quantity of eggs used decreased. The total quantity of cocoons produced in 1918 was 68 million kwan (1 kwan =8·27 lbs.) and in 1928 it was 93 million kwan. This state of affairs is due partly to improvement in seed and silk-worm races, and partly to more people having taken up rearing of summer and autumn crops as *artificial hatching* became more universal.

In 1928, out of a total production of 93,849,090 kwan of cocoons, 80,979,196 kwan were good cocoons, while double cocoons formed 8,388,901 kwan and waste and inferior cocoons, 4,480,993 kwan, or, 86 per cent were good cocoons, 8·6 per cent were double cocoons, and 3·4 per cent were inferior and waste cocoons. 53 per cent of the cocoons are from spring crop, while summer and autumn crops are responsible for 47 per cent of the total output of cocoons.

The total number of rearers in 1918 was 1,910,769, while in 1928 it was 2,165,265.

Raw Silk Production.

The total number of reeling establishments in 1918 was 255,750, with 626,740 basins. In 1928, the corresponding figures were 76,090, and 435,735, respectively. This indicates that reeling moved more towards factory system and filature type from cottage and foot reels. The total quantity of silk produced in 1918 was 5,795,542 kwan (value=Y. 526,708,280), and in 1928 it rose up to 10,584,232 kwan (value=Y. 835,467,904). The total quantity of waste of all denominations rose from 2 million kwan to 4 million kwan, with a value of about Y. 22,000,000. In 1918 the number of filatures was 4,639 (with 275,760 basins) producing a total quantity of nearly 5 million kwan of raw silk. In the same year, the number of foot-reel and other establishments was 206,267 (with 281,977 basins). These establishments produced nearly 6 lakhs of kwan of silk, with a total value of 15 millions yen. In 1928, the total number of filatures was 3,509 only, while the number of basins increased to 318,540. This means that the average size of filatures increased from 60 basins each to 90 basins. The real state of affairs is that almost all joint-stock filatures are above 250 basins, while co-operative filatures are never more than with a capacity of 60 basins. The larger filatures are all above 500 basins. By the same year, the number of foot-reel and other establishments had gone down to 62,088 with only 85,363 basins. The above figures clearly indicate how rapidly factory filature replaced old home reeling establishments.

The number of doupions establishments was in 1928, 10,493 with 31,832 basins and with a total production of 654,815 kwan of double cocoon silk as against 44,844 establishments, 69,003 basins, 466,954 kwan of doupions silk in 1918. A fairly large quantity of doupions silk is imported into India and sells cheaper than Mysore raw silk.

Silk Waste, Etc.

The total quantity of silk waste of all grades in 1918 was 2,094,592 kwan while in 1928, it rose to 3,940,601 kwan. For every 2·76 lbs. of silk in 1918 1 lb. of waste was got. In 1928, the ratio was 1 to 2·7. Of late, larger quantities of silk waste are used in Japan for spinning, while exports are proportionately reduced.

The total number of operatives employed in reeling establishments in Japan is 515,504.

Organization.

Sericulture proper is in charge of Agricultural and Forest Ministry. Sericultural education is in charge of Education Ministry. The Agricultural and Forest Ministry has one bureau for sericulture, which has two sub-bureaus:—

SERICULTURAL BUREAU.

I. Sub-bureau for sericulture proper. This sub-bureau has charge of:—
   (1) Imperial Sericultural Station.
   (2) All Prefectural Experimental, and Inspection Stations.
   (3) Sericultural Co-operative Societies.
   (4) Raw Silk Association of Japan, and Imperial Sericultural Association, Japan.
   (5) Encouragement connected with the above.

II. Sub-bureau for cocoons and filatures. This sub-bureau has charge of:—
   (1) Filature Industry.
   (2) Conditioning and Test Houses.
   (3) Cocoon Drying Societies.
   (4) Filature Guilds.
   (5) Co-operative Filatures.
   (6) Encouragement connected with the above.

Besides the above, there are two committees, *viz.*, (1) committee for improvement of sericulture, (2) committee for store houses and *drying of cocoons*. These are non-official bodies with expert advisors, and presided over by the Agricultural and Forest Ministry. There are similar committees in prefectures where sericulture is in existence.

Finances.

The total budget (for Japan) for 1927-28 was Y. 1,759,000,000. The apportionment of expenditure among the departments was as follows:—

		Y	Percentage against total.
1.	Household	4,000,000	0·229
2.	Foreign Affairs	20,000,000	1·145
3.	Finances	416,000,000	20·000
4.	Interior	265,000,000	13·000
5.	War	212,000,000	10·000
6.	Navy	256,000,000	11·000
7.	Justice	37,000,000	0·210
8.	Education	140,000,000	7·000
9.	Agriculture and Forestry	49,000,000	2·500
10.	Commerce and Industry	11,400,000	0·500
11.	Communications	344,000,000	19·000
12.	National Debt Consolidation ..	286,000,000	16·000

Budget for Sericulture.

This is divided into two, *viz.*, Imperial and Prefectural. Imperial grants are defrayed from national treasury, while prefectural grants are met by prefectural governments.

(*a*) Imperial Budget for Sericulture.—

		Y
1.	To Improvement of Mulberry	22,600
2.	To Improvement of Cocoons	37,000
3.	To Investigation of Diseases	173,000
4.	To Aid to Raw Silk Association	13,000
5.	To Aid to Straw-wares, Drying of Cocoons	604,800
6.	To Imperial Experimental Station	294,183
7.	Silk Examination	438,233
	Total ..	1,582,816

(*b*) Prefectural Budget for Sericulture.—

1.	To Improvement of Mulberry	560,000
2.	To Improvement of Sericulture	324,000
3.	To Improvement of Eggs	60,000
4.	To Improvement of Silk	231,000
5.	To Seed Inspection Stations	2,412,577
6.	To Sericultural Institutes or Stations	1,754,681
7.	To Silk Examination	63,065
8.	To Sericultural Education	644,454
9.	To Miscellaneous	152,671
	Total ..	6,202,448
(*c*)	Three Colleges	512,000
	Grand Total ..	8,297,264

(Or nearly a crore and a quarter of rupees.)

As compared with the total expenditure, the actual realisation of money is negligible. The *policy* adopted is that of encouragement and improvement of the industry. This is the reason why no stress is laid on actual realisations. A large amount is spent on inspection stations which exist primarily for inspection of seed and control of diseases. The money spent on rearings is almost unremunerative as layings prepared out of seed cocoons produced are distributed free to seed-makers for seed cocoon rearings. Sericultural educational institutions are maintained to train staff for the various stations, and to dissiminate knowledge. Money spent on experiments practically brings forth no realisations. Filatures or reeling establishments are installed not for commercial but for educative purposes, or for assisting the several purchasers of cocoons in stabilising

cocoon prices on scientific lines by conducting reeling tests, which enable the purchaser to pay on actual reeling quality and renditta of cocoons.

Experimental and Inspection Stations.

There are two kinds of experimental stations, *viz.*, Imperial sericultural station, and prefectural experimental (sericultural) stations. There is one Imperial sericultural station in Tokyo, and has six branches in six different Provinces. This is directly under the control of the Agricultural and Forest Ministry. There are forty-seven prefectural stations, one for each prefecture. These stations are under the direct control of the Prefectural Governor who is responsible for all sericultural work in his prefecture to the Minister for Agriculture and Forestry. Under the Sericultural Law of Japan, each sericultural prefecture is required to have an inspection station with several subordinate stations for inspection of seed and for control of diseases. There are forty-seven prefectural inspection stations. The experimental (prefectural) stations may have the prefectural inspection stations under their control, or the inspection stations may work in direct subordination to sericultural bureau of the Governor's Office, according to local circumstances and administrative conveniences.

Imperial Experimental Station.

This station exists mainly for research work in all subjects connected with sericulture ; improvement of silk-worm races, etc. ; genetical work ; improvement of mulberry varieties ; improvements, etc., in filature work ; research work in chemical aspects; cold storages, etc. One more important function is to act as a consultative body in all sericultural matters for the experimental stations of prefectures.

This station has six branch stations in six different provinces for experimental work, and for preparing " original " silk-worm-seed of new races and breeds for distribution to prefectural stations. Some of these stations are used for testing and verifying laboratory scale results on a large scale.

The Imperial station has six departments, *viz.* :—

(1) *Mulberry Department.*—This department carries on research work and experiments connected with mulberry, distributes newly evolved mulberry varieties to different prefectures. It arranges for extension lectures on mulberry cultivation. It is in charge of an expert who is a scientist. His classical research work is on mulberry cytology.

(2) *Department of Biology.*—This has three distinct branches, *viz.*, genetical, physiological (including work on voltinism), and a branch for silk-worm races. This branch is similar in function to mulberry department. The one great work done in genetical section was to reduce the number of silk-worm races, and to improve them, and to evolve new races by genetical methods. Its rearing branch rears worms of new varieties and distributes to prefectural stations for further multiplication and distribution to seed-makers.

The recent classical reseach work done in this section comprises of work on silk-worm chromosomes and gynandromorphs. It provides working formulæ in silk-worm hybridisation work to experts of prefectural stations. The section connected with silk-worm races concentrates attention on comparative data concerning various silk-worm races, both for scientific and practical purposes. The physiological branch carries work in pure and applied physiology of silk-worms, voltinism branch carries work on voltinism. Much of the work done in all these branches is of a scholarly and scientific nature.

(3) *Department of Pathology.*—This department has three branches, *viz.*, bacteriological branch for flacherie, etc., mycological branch (both for silk-worms and mulberry). Extensive experiments are being conducted on " ionic values " of silk-worm, suffering from flacherie and allied diseases, and on bacteria found in silk-worms suffering from flacherie. The exact causes of flacherie are being diagnosed. There is much valuable information on this subject.

Pebrine.—After Stempell and Kudo important research work in pebrine has been done here *re.* nature of polar filament of "Noseme Bombycis." The mycological section does work in silk-worm and mulberry fungus diseases. The pathological department suggests ways and means of prevention of silk-worm diseases, as also of mulberry.

(4) *Department of Filature.*— All experiments and researches in reeling technique and allied subjects are carried on in this department, as also in several kinds and types of filature basins. For the past five years, this branch has been doing experiments in the classification of cocoons (Japanese). The results of these experiments which are elaborate will be published next year. There is a mechanical section which carries on research work, and experiments in all kinds of machinery connected with reeling and testing of silk. Harada's deniergraph is the most accurate instrument constructed for recording deniers for research and experimental work. There is one more branch for experiments and researches in physical properties of raw silk. This section has the most elaborate and accurate set of instruments for work. All these were constructed by the expert himself. The "Kilcha" weighing balance being the most ingenious instrument weighing accurately to one-thousandth of a milligram.

(5) *Department of Chemistry.*—This branch carries on experiments and researches on all subjects connected with sericulture. The chemico-physiological work done here is one of the outstanding contributions on the nutrition of silk-worms. A large amount of chemical work has been done on "reeling" silk. Manures form a good portion of the work. Analyses of sericultural products is one of the routines. Very valuable work has been published in Japanese language in this section.

(6) *Department of General Affairs.*—This department deals entirely with the administrative work.

There are altogether 17 experts for the various departments in addition to assistants and other workers.

There is a practical course of filature training to train experts in cooking cocoons (male attendants) and to train instructresses in filature technique. The total number of trained attendants since 1915 is 400 male, and 1,000 female attendants. Short course lectures are now and then delivered for the benefit of filature workers. Lectures on mulberry cultivation and silk-worm rearing are given from time to time.

All the laboratories are well equipped in scientific appurtenances. There are up to date air and humidity conditioned rooms for rearing worms for bacteriological and genetical work. All departments are well furnished with libraries and scientific magazines and periodicals. No students are admitted for training as the institution is maintained purely for research and experimental work.

Prefectural Experimental Stations and Inspection Stations.

Each prefecture has an experimental station with branches wherever necessary. This works under the Vice-Governor who has a bureau for sericulture. The bureau chief is an expert in sericulture or a junior civilian. For each section there is a technical assistant in the Bureau Office. The experimental station is directly under a Director who is a sericultural expert of fairly long standing, a graduate of a sericultural college. Generally speaking, the work is divided into (1) Sericulture (includes experimental rearing work in genetics, diseases, rearing of silk-worms for original seed, and preparation and examination of "original seed"); (2) Mulberry section for growing mulberry for rearings, for experiments, and a chemical section for work on chemical side; (3) Sericultural co-operation; (4) Filature for experiments in reeling and for testing of cocoons of various co-operative societies; (5) Administrative branch for general office work, and for encouragement connected with the industry. Generally speaking, each branch has an expert who is responsible for all work in his section. The number of assistants in each branch depends upon the magnitude of the work turned out.

Staff.

DIRECTOR

(1) *Sericulture.*—One Chief Expert, 1 Expert, and 2 to 3 Assistant Experts for each branch, *viz.*, Pathology, original seed rearing, preparation of seeds, besides assistants and temporary assistants in season.

(2) *Mulberry.*—One Expert in charge. One Assistant for mulberry cultivation. One Assistant for diseases, one for physiology and one for entomology, and 2 to 3 for chemical work.

(3) *Sericultural Co-operation.*—One Assistant Expert or Expert. 3 to 4 Clerks.

(4) *Filature.*—One Assistant Expert, 2 to 3 Lady Supervisors, one or two Assistants for tests and general work.

(5) One Expert or Assistant Expert with several Clerks.

Besides the work already mentioned, the experimental station trains students in rearing and other work. Lectures to students are delivered from November to April, *i.e.*, in the off-season. In the off-season, the mulberry department and other departmental staff check statistics collected by the subordinate inspection stations.

Filature Section.—The filature besides carrying on experiments, and sending lady instructresses to various filatures for improving reeling technique, carries on "cocoon quality tests," and issues certificates.

Cocoon markets in Japan are ruled by what is called "Kakeme" which means relative value of cocoons. Suppose the Silk Exchange in Yokohama declares the price of silk at Y. 1,350·00 per picul (one picul has 100 kin and each kin is equal to 160 momme = 1·33 lbs., *i.e.*, 1 picul = 133 lbs.), the filatures offer Y. 1,000·00 as the total price payable for that quantity of cocoons which produces 100 kin of silk, *i.e.*, 1 picul, deducting Y. 350·00 as costs of production, etc. This Y. 1,000·00 is divided by 16 (as each picul consists of 16 kwan, and one kwan is 8·27 lbs.). The quotient, *viz.*, 62·5 is the "Kakeme" or the relative index. If cocoons on visual inspection are supposed to produce 10 per cent of silk, then the price of 1 kwan of cocoons is calculated as:—

$\frac{\text{"Kakeme"} \times 10}{100}$ = price per kwan of cocoons. Substituting $\frac{62{\cdot}5 \times 10}{100}$ = Y. 6·25.

If the percentage of silk is supposed to be 12, then the corresponding price per kwan of cocoons is $\frac{62{\cdot}5 \times 12}{100}$ = Y. 7·5 and so forth. It may, in passing, be mentioned that "Kakeme" is governed by silk prices, quality of cocoons, and costs of production of silk. It is assumed while transacting business that a rate of Y. 6·25 will be paid if cocoons produce 10 per cent of silk on reeling. Should the cocoons on actual reeling give only 9 per cent of silk, then the prices to be actually paid would be only Y. $\frac{62{\cdot}5 \times 9}{100}$ = Y. 5·625 per kwan and so forth. The Government filatures carry test reeling of 400 momme (1 momme = 3·75 grams) of cocoons and issue reeling certificates to the institution or parties that sent the cocoons for reeling. The purchasers pay the price of cocoons as per tests got. This is a very important work. The Experimental Station Filature in Kumagaya carries tests for 10 to 11 thousand lots of cocoons a year.

A prefectural station may have a few subordinate experimental stations for work. In brief, the experimental station conducts experiments to find out suitable varieties of mulberry and silk-worm races for its jurisdiction, and carries on research work, supplies a portion of original seed to seed-makers, popularizes "encouragement breeds of silk-worm races," supplies "encouragement varieties of mulberry" to nursery owners, offers advice and guidance to sericultural guilds of various denominations, carries on economic inquiries, acts as an advisory body on the various institutions, to individual sericulturists, tests cocoons in filature, trains students, etc.

N.B.—Encouragement breeds or varieties in silk-worms and mulberry are such breeds that have proved to be very good and profitable in particular prefectures. These are determined by a large number of experiments beforehand. Each prefecture may have its own encouragement breeds in preference to other varieties.

Inspection Stations.

The Sericultural Law of Japan requires that all silk-worm eggs to be reared, whether cellular or industrial, should be microscopically examined, and certified

to be disease-free as per prescribed tests, etc., under law, exception being made in case of research, experimental, and educational work. This necessitates existence of Inspection Stations in all prefectures with sufficient staff to carry on microscopic examination of all layings prepared by the seed-makers. Each prefecture has one Inspection Station, and each county has one subordinate Inspection Station. (In Japan prefectures are divided into counties, and counties into villages. Prefectures are comparatively smaller in area to our districts. Generally a prefecture has 8 to 10 to 12 counties according to its extent and population.) The prefectural Inspection Station is under charge of a sericultural expert of experience. In many a place it is under the control of the director of the Experimental Station. In such cases, the work of the two institutions is not allowed to overlap, but is kept distinctly separate. The prefectural Inspection Station controls in technical and administrative matters its county stations. The County Stations may have subordinate stations as well, where the jurisdiction is big.

The prefectural Inspection Station has one director, and should the director be the officer of the prefectural Experimental Station also, a separate expert is always in charge of work of the Inspection Station. There are a number of assistants both for technical and office work. This station does not only supervise administrative work, but also carries on microscopic examination of layings of the headquarters County Station. Each County Station is in charge of an officer of the rank of an expert, assisted by several assistants and an office. The most important work that is done is microscopic inspection of moths of all seed-makers in the county. The seed-makers in a county are all subject to control of the County Station. A seed-maker is allowed to rear only cellular layings supplied by Government Experimental Station, or cellular layings prepared by himself. The Experimental Station of the prefecture generally supplies about 30 per cent of the total requirements of the "original seed" to the seed-maker. As the rearings are in progress, the expert or his staff inspects the rearings from stage to stage for diseases, etc. When the rearings are approved by the County Stations as fit for "seed" purposes, then the seed-maker harvests cocoons for seed, and prepares seed according to rules prescribed under regulations. During the course of preparation of seed the County Station inspects the operations. When all the operations are over, the seed-maker carries all moths in regulation cellules, and also the egg-cards, or laying sheets, in the prescribed manner according to breed, crop, voltinism, etc., and deposits them in the Inspection Station of his county. This operation commences in the end of July or beginning of August. The moths and layings are all classified and examination commences. There are two kinds of examinations, *viz.*, Cellular and Percentage Examinations. In the cellular examination *all* the moths are examined for pebrine, while in the percentage examination, *ten per cent* of the moths is examined, and should this quantity satisfy the required test, *viz.*, of pebrine being less than 1 per cent in the 10 per cent of the moths taken for examination, then all the layings are certified "disease-free," and, on the other hand, if the incidence of pebrine is above 10 per cent for the whole lot, cellular examination of that lot of seed is arranged for. In Japan, microscopic examination is carried only for pebrine, as that is the only hereditary disease, and as bad rearings are eliminated during the course of rearing. After all the examination is over, the bad layings are rejected and certificates or seals are affixed. The layings are delivered to the respective seed-makers who arrange for "cold storage" and subsequently arrange for sales directly or through seed-brokers.

The Inspection Station enforces all sericultural laws, especially relating to pebrine and "fly" diseases, the latter being common in Japan in the spring season. It advises sericulturists in all sericultural matters, collects sericultural statistics, supervises, encourages, and forms sericultural guilds of all denominations, inspects mulberry nurseries and controls the work of its sub-stations.

Equipment.

Each County Inspection Station has a few centrifuges for tests, *re.* pebrine. This facilitates work very much, as silk-worm moth fluid gets concentrated and

pebrine is easily detected if any is present. There are one or two circular moth crushing machines, generally of the big size. This device facilitates moth crushing work considerably, as also that of preparation of slides, and it is more hygienic. Besides, chances of error are few. This machine is worked by a small motor and has water pipe connections. Each station has 20 to 30 microscopes on a minimum, while bigger Inspection Stations may have as many as 40 to 50 microscopes. These microscopes are of the common type we have here. Each examiner has a separate table and chair for her work. All the seats are serially and sideways arranged and the hall has a large number of windows to admit of plenty of light for microscopic examination. The examiners are not officials, but *are girls who hold licensed certificates as examiners*, and are employed during the season only paying Y. 0·70 to 0·90 per head daily. They work from 8 A.M. to 12 NOON and again from 1 to 4 P.M. The girls employed for arranging moths serially, etc., in the mortars and to mark out in the rough register concerned, also the girls working at the moth crushing machines, slide, etc., cleaners, are all appointed for the season and dismissed so soon the work is over. There is an assistant in charge of the store of egg-cards and moth cellules. He attends to deliveries from his branch. The receiving assistant supervises work of the "Consigners" of moths in mortars, of girls working at the machine, of girls employed for cleaning slides, etc., and of those engaged in transport of slides, etc. A girl that consigns moths from cellules to mortars attaches the "serial number" slip to the mortar holder. This slip is attached finally to slide holder. The examiner ticks the results of the examination and passes her slides to the "Supervisor," who checks 10 per cent of all the slides. Thus, a group of 4 or 5 microscopes has a supervisor for technical check of the work. If the original examination is found unsatisfactory, the examination is done once again. After the final check the record slip is passed on to the technical assistant in the office who groups together all such records slips, consolidates, and prepares a statement of examination of each seed-maker. Another assistant receives this statement and gets all the rejected layings removed according to this statement, and after obtaining final orders of the officer of the station "seals" or certifies as "Passed", or "Unpassed", according as the percentage of pebrine is below the one admitted under Law or above it. After all examination is over and records are complete and certificates are passed, the seed-makers are notified of the same. They remove the layings to their individual grainages.

Every Inspection Station has a sufficiently big hall for microscopic examination, and a cellar for depositing egg-cards, with suitable racks and holders for the sheets. It has a room for conserving moth cellules. There is a separate room for examining egg-cards for minor defects, such as poor layings, etc., for removal of rejected layings. The office has a big reception room for meetings or work with the seed-makers. The Inspection Station may be combined with a sub-experimental station under the supervision of the same officer. In no case is the work of the one allowed to overlap the work of the other. The work of the sub-experimental station is just the same as that of the prefectural station on a small scale.

The Subordinate Inspection Stations are under the control of the County Inspection Station in each county when they exist. Generally there is an assistant only to look after the work. He tours round the villages, inspects and guides rearings of the seed-maker, visits guilds, collects cocoon-market information, makes notes of crop conditions, collects data and *statistics*. Since his jurisdiction is limited, and since facilities for touring exist, his itineration is very satisfactory. Being an educated and well trained man his work is dependable.

Prefectural Control Stations, Etc.

(*a*) *Office Work*:—
Manager 1.
Technical Assistants 2 to 4, according to size and work of the prefecture.
2 to 4 clerks. Work is administrative and compilation and consolidation of all statements and statistics, etc.
Is in immediate charge of an Expert or the Director.

(*b*) *Technical and Executive Work*:—
1 Director.
1 Expert.
2 Assistant Experts.
2 to 6 Assistants.
2 to 6 Clerks.
(*c*) *County Station*:—
As in (*b*.)

Inspection Station popularises the several encouragement breeds and varieties of silk-worms and mulberry suitable for the locality as advised by the experimental station. It starts cocoon-drying guilds and helps the guild in its technical work. It practically attends to all work connected with sericultural law, several ordinances, orders, and measures for the development and progress of the industry in its jurisdiction. It is in fact the executive organ of the sericultural organization of Japan.

Sericultural Education in Japan.

College Education:—There are three sericultural colleges, one at Tokyo, one at Kyoto, and one at Uyeda. The minimum qualification required for admission into these colleges is graduation from a middle school (to pass out of a middle school in Japan it takes eleven years, and middle school education corresponds to our high school education, and in fact its standard is higher than that of our Secondary School Leaving Certificate course). Admission into these colleges is by an open competitive examination in several subjects. The number of seats in each college is restricted as definite accommodation is to be provided for practical work in chemistry and rearing, bacteriological and anatomical laboratories. These colleges are under the Ministry of Education.

There are three courses, *viz.*, Moriculture, Sericulture, and Reeling, in all the Colleges. *Uyeda College* has an additional course for silk-waste spinning. Each course is for three years. The common general subjects taught are Japanese language, English, Physics, Chemistry, Algebra, Geometry, Trigonometry, Botany, Zoology, Histories, and Geography, German or French, Entomology, Soils and Manures, Co-operation, Rural Sociology, Conditioning and Testing of silk, Silk market and Exchange. Rearing of silk-worms, mulberry cultivation, reeling, sericultural economics, grainage work, organization of sericultural industry are common subjects. Sericulture course has a higher standard in genetics, silk-worm rearing, anatomy, and physiology of silk-worm. The Reeling or Filature course pays more attention to reeling and filature technique. Similarly Moriculture pays more attention to moriculture. The silk-waste spinning course in Uyeda gives actual practical training in silk-waste spinning and machinery employed. The year is divided into three terms.

The following is the schedule of studies:—

Sericulture Course:—*First Year*:—Per week lessons are held in practical Ethics for 1 hour, Mathematics 3 hours, English 6 hours, German or French 2 hours, Zoology 4 hours, Botany 3 hours, Physics and Meteorology 3 hours, Chemistry 3 hours, Outlines of Sericulture 2 hours, Education of Silk-worms 2 hours, Gymnastics 2 hours, Zoological and Entomological Practical Work 3 hours, Botanical and Plant Pathological work 3 hours, Chemical Laboratory 3 hours, and Farm Practice 2 hours (the last one only in the first and second terms). This makes 40 hours work per week.

Second Year Course:—Per week classes are held in Practical Ethics for 1 hour, English 5 hours, Entomology 3 hours, Physics and Meteorology 2 hours, Soils and Manures 3 hours, Education of Silk-worm 2 hours, Anatomy and Physiology of Silk-worms 2 hours, Microbiology 1 hour, Pathology of Silk-worms 3 hours, Filature 2 hours, Gymnastics 2 hours, Zoological and Entomological Laboratory 3 hours, Farm Practice 3 hours, Silk-worm Anatomy (Practical) 3 hours, Practical Work in Silk-worm Diseases 3 hours. In addition to this, in the First Term, Silk-worm Rearing is for 14 weeks and Grainage Work for 3 weeks. This makes 41 hours work per week. In the Second Term, there is Practical Rearing Work for 3 weeks, as also Grainage Work for a similar period.

Third Year Course:—Per week classes are held in Ethics (Practical) for 1 hour, Plant Pathology 2 hours, Outlines of Agriculture 2 hours, Laws and Economics 4 hours, Agri-Sericultural Economics and Politics 4 hours, Bio-Chemistry 3 hours, Mulberry Cultivation 3 hours, Genetics 3 hours, Anatomy and Physiology of Silk-worm 2 hours, Pedagogics 1 hour, Gymnastics 2 hours, Practical work in Anatomy 3 hours, Practical work in Silk-worm Pathology 3 hours. In addition to this there is Practical Work in rearing for 14 weeks in the First Term and 3 weeks work in each term in Grainage. Altogether, 42 hours work in Filature should be done. There is 33 hours work in a week. Besides, students in Second and Third Years should select some subject and do research work.

In Filature and Moriculture courses, subjects relating to those branches are given more prominence.

In addition to the above courses there are subsidiary courses in Sericulture for one year for practical men, and in Filature for girls. From time to time, there are abbreviated courses in Sericulture and Filature.

The strength of the college in Tokyo in 1929 stood at :—

No.	Course	1st Year	2nd Year	3rd Year	Total Number
1.	Sericulture	30	30	34	94
2.	Moriculture	20	20	17	57
3.	Filature	30	30	27	87
4.	Practical	40	..	..	40
5.	Girls (Filature) ..	40	40	...	80
	Total ..	160	120	78	358

The number of students in Uyeda and Kyoto colleges is about 15 per cent less than that in Tokyo college.

The students of Sericulture and Moriculture courses after graduation are generally attached to one of the Professors as apprentices for one year, and then sent out to experimental stations as assistants, where they remain as apprentices for one year. In any case they will not be given any independent work till they have had full opportunities of working satisfactorily in the several branches. These assistants subsequently rise to the ranks of assistant experts and experts, and the more fortunate ones to be directors of experimental stations. A few filature graduates are sent out to Government filatures, and most of them are absorbed by private filatures as assistant experts, supervisors, etc. Finally, they may be put in charge of filatures. Graduates of practical course may become assistants in experimental stations, finally, assistant experts, and in rare cases experts. Most of them do their own work as rearers or seed-makers. Girl graduates may be absorbed by Government filatures, and most of them go out to private filatures as supervisors or teachers. The college graduates go out as teachers to prefectural sericultural schools too. Formosa and Korean Sericultural Departments absorb quite an appreciable number. The South Manchuria Railway Company appoints a few.

The colleges inculcate a spirit of scientific investigation and research which pervades all sericultural work in Japan. This is one of the important reasons why organization is not only effective but progressive.

Staff of the Colleges:—There is a Director, and 16 to 17 Professors for subjects already enumerated in the courses of colleges. Most of them have had the benefit of research work in foreign countries. In addition to Professors, there are Assistant Professors for several branches, and each branch has several assistants. Besides, there are Lecturers also according to requirements of any particular subject.

Equipment:—All the colleges have suitable and necessary buildings for offices, reception rooms, meeting hall and laboratories for Chemistry, Anatomy, Bacteriology, Pathology, Rearing Houses (at least three buildings, each having 8 rooms of the capacity of 10′×12′, with an underground leaf store of 30′×20′×8′,) moriculture laboratory, filature, and a mulberry garden of not less than 12 to 15 acres. All the Laboratories are well provided with necessary electrical, mechanical and other appurtenances for work of students, as well as for research work of Professors who are expected to and who do really valuable research work. Full

opportunities are afforded to students in practical work. There is a well furnished general library attached to each college. Besides, each department has its own library for routine and research work. In addition to books in Japanese a fairly large number of books is made available in French, German, Italian, and English. Uyeda college has a silk-waste spinning and artificial silk manufacturing plant. It has a splendid chemical laboratory. Kyoto college specialises in electrical apparatus for hatching silk-worm eggs.

The colleges have one dormitory for boy students, and one for girls.

The Imperial University in Kyushu and the Agricultural University in Tokyo teach sericulture also. The Agricultural University in Tokyo provides Professors to the Sericultural Colleges as also Experts to Imperial Experimental Station.

Prefectural Sericultural Schools:—These schools are of the standard of middle schools. These institutions admit graduates of higher or lower primary schools. Courses are generally for three years. But, in a few cases, five years' course may also exist. The five years' course is intended for graduates of lower primary school, while the three years' course admits graduates of higher primary schools.

The subjects taught are Japanese Language, Ideographs, Arithmetic, Algebra, Calculation by Japanese Counter, Botany, Zoology, Physiology, Geology, Mineralogy, Physics, Meteorology, Physical and Chemical Experiments, Japanese History and Geography; Foreign Geography, Oriental History, European and American History, Agriculture, English, Agricultural Economics, Book-Keeping, Rearing of Silk-worms, Anatomy, Physiology and Pathology of Silk-worms, Reeling, Utilisation of Silk-waste, Mulberry Cultivation, Horticulture. Suitable arrangements exist for practical work in all sericultural subjects. Besides these schools maintain good museums. Generally a small but decent filature is fitted up. Some schools like that of Okaya school in Nagano prefecture have splendid filatures with up-to-date silk-testing machinery. Some of the schools have already abandoned the Japanese wooden houses, and have constructed ferro-concrete buildings.

Out of forty-seven prefectures, sixteen prefectures maintain sericultural schools. Where no sericultural schools exist, the agricultural schools serve the purpose as they teach sericultural subjects. There are altogether 225 agricultural schools, where sericultural subjects form part of curricula. In addition to this, sericultural schools are founded by private organizations or gentlemen. Some of these schools are as good as any of the sericultural prefectural schools. But mostly their standard is lower than that of the Government institutions. The prefectural experimental stations provide educational facilities.

The graduates from prefectural sericultural schools mostly go back home and do their own work, either rearing or seed-making. A typical school which sent out 537 graduates states that 67 per cent of these graduates set up their own work, 8 per cent went up for higher qualifications, 7 per cent took to Government service, 7 per cent to teaching profession, 6 per cent took up business, and 3 per cent were dead. The teachers and experts employed in guilds are mostly graduates of prefectural sericultural schools, or graduates from experimental stations. These teachers and experts keep a living contact, on the one hand, with the general sericulturist, and, on the other, with institutions and consulting bodies.

Thus, sericultural education in Japan is not only extensive, but also specialised. It affords full opportunities to all classes of teachers, experts, and research workers. The benefit accruing from graduates of sericultural schools, as also from those of agricultural schools settling in life as farmers and sericulturists, is immense. These practical workers carry the scientific and practical training with them and develop work in their own spheres, either as rearers or seed-makers, etc.

Sericultural Co-operation.

The guild system in Japan in all branches of all industries exists on an extensive scale, and is specialised. There are two kinds of guilds, *viz.*, ordinary guilds

and guilds coming under the category of "Same Profession Industrial Products." In the ordinary guild, membership is voluntary. In the latter case, such a guild can be started when two-thirds of the members of a particular locality of the same profession consent and membership becomes compulsory. The following is a brief description of the various kinds of guilds in existence:—

(1) *Silk-worm Rearers' Village Guild*:—Generally there is one guild in each village. But, in big villages there may be two or more guilds. In this case, all unite into one league. The objects of these guilds are:—(*a*) to select and standardize varieties of silk-worms for their respective areas, (*b*) to buy silk-worm eggs and other things co-operatively, (*c*) to rear "chawki" together, (*d*) to employ experts to improve the technical side of the industry, (*e*) to have model plantations, (*f*) to extend and improve mulberry farms and to have special farms for autumn and summer, (*g*) to prevent diseases of mulberry, (*h*) wherever possible *to have cocoon markets*, (*i*) to sell cocoons jointly, (*j*) to hold competitions and exhibitions, (*k*) to have sericultural instruments, etc., for use of members, (*l*) to accumulate reserve funds, (*m*) to have co-operative savings, (*n*) to render monetary assistance, (*o*) to collect and keep accurate statistics, (*p*) to co-operate with experimental stations in popularising "Encouragement Breeds" of silk-worms and of mulberry, (*q*) to arrange for lectures and demonstrations, (*r*) to bring to the notice of Government such matters as are necessary for development of the industry from time to time, (*s*) to respond to enquiries, etc., of Government institutions.

It may be said that almost all sericultural villages in Japan have guilds. The total membership is 25 per cent of all the rearers of Japan. In the course of a generation or more it is intended to bring all the rearers within the influence of the guilds. This guild belongs to the ordinary type, or in unusual case to the other type.

(2) *County League of Rearers' Guild*:—All the rearers' guild in a county are affiliated to the County League of Guilds. The objects of this league are to establish relationship between its constituents, and to communicate with other sericultural bodies. This league is generally situated in the Control Station or in the County Administration Office. It is financed by the component guilds proportionately to the membership of each guild, etc.

(3) *Prefectural League of Rearers' Guild*:—This league is composed of all the county leagues of rearers' guilds. The objects of this league are to improve sericultural industry by co-ordinating the activities of its constituent guilds, and by establishing friendship with similar bodies. It investigates measures relative to the improvement of the industry, guides its component guilds and helps them, furnishes information to Government enquiries, places before Government measures calculated to improve the industry. It distributes the subsidies given by Government to the various guilds. It is financed by its component bodies proportionately, and it receives subsidies from Government and contributions from other sources. It takes measures to open new guilds.

(4) *Prefectural Guild of Silk-worm Seed-Makers*:—Every prefecture has a guild for all the seed-makers in the prefecture. This guild belongs to "Same Profession Important Products" Association. It may have a branch each in a county, when found necessary. All the guilds of the seed-makers are members of the Raw Silk Association of Japan. The aim of this guild is to remedy existing defects in the work of seed-makers, to promote profits and to develop work. Its work is to study sericultural industry, improve existing matters, to improve the existing breeds of silk-worms, to arrange for lectures and training courses, to suggest to Government measures calculated to improve the industry, to reward employees who work for long periods, to fix maxima and minima of prices of egg-cards, and any other matters that concern the industry. *Members should carry out microscopic examination of eggs, worms, and moths, and they are required to reject the lot of worms which is pebrinised:* forced emergence of moths should be carried out for preliminary examination and when more than *3 per cent of pebrine* is found, that lot should be rejected. Disobedience of rules and bye-laws of the guild is severely punished by heavy fines. This guild is a very important guild that practically gives effect to the important principles in the manufacture of good seed of improved varieties of silk-worms, takes all necessary precautions

against pebrine disease, and guarantees in an implied way excellent seed. It also creates good understading among its members by stopping unhealthy competition.

(5) *Prefectural Guild of Mulberry Nursery Owners*:—This guild may be of any one of the two types, *viz.*, guild of the "Same Profession Important Products" or ordinary guild. Government recently have been laying emphasis on the formation of the first type, as it is considered that good mulberry nurseries are essential for a sound basis of the industry. Each county may have a branch of its own. Growers and sellers of mulberry saplings and grafts are members. These members are generally *very poor*. Without an organization of this type, it would be impossible to effect improvements in moriculture. The restrictions and obligations imposed in this guild are very stringent to enable rapid improvement of mulberry "stocks." The work of this guild is to investigate quality of mulberry, investigation of species and varieties, popularisation of "encouragement" varieties, increase of sales of mulberry stocks, establishment of model mulberry gardens, improvement in methods of packing and transport of mulberry stocks, protection against diseases and pests, arbitration of differences among its members, *inspection of mulberry grafts and plants for "passable" and "unpassable" ones*. The last named is the most important practical work done by the guild. Standards are fixed for passable grafts, and those below standards are unpassable. Only passable grafts and plants are allowed to be sold. The inspector of the society inspects each plant of the nursery owner. The guild is financed by the members.

(6) *Silk-worm Seed and Cocoon Brokers' Guild*:—This guild is of the ordinary type. Its members are seed or cocoon brokers or of both residing in the prefecture. The object of this guild is to eradicate evil practices existing in the trade. A license is necessary from the Governor for starting broker's business in seed or in cocoons. This is a Prefectural Guild.

(7) *Silk-worm Seed Dealers Guild*:—This guild comes under the type of "Same Profession Important Products Guild." Generally there is one for each prefecture. Counties may have branches. It aims at removal of defects and improvement of the industry. Its work consists of research into quality of seed, distribution of seed of good quality, acting as intermediary between co-operative buyers and sellers of seed. It arranges for lectures, training courses, research into management methods, sends investigators in search of good seed, finds out places where seed could be sold, co-operates with other bodies.

(8) *Cocoon, Silk Brokers' Guild*:—This may be either of the ordinary type or of the type of "Same Profession Important Products Guild." Its aim is to improve the work of members. Its work consists in seeing that spring, summer and autumn cocoons are not mixed, that different kinds of silk are not mixed in one and the same lot, thick and thin, good and bad, good and bad cocoons are not mixed in reeling, to prevent chrysalides being added to waste in "business," not to allow any other material to be added to silk-waste to increase weight. Members are those engaged in raw silk trade or agents, those engaged in manufacture of inferior grade of silk from low grade cocoons, and dealers in such silk, those engaged in inferior cocoon trade, etc. The member has a badge of the guild as a mark of his membership.

(9) *Filature Guild*:—This is of the type of "Same Profession Important Products," and there is only one for a prefecture. All filatures of the prefecture are members. Fees are collected proportionately to the number of basins each filature has. This guild is a member of the Raw Silk Association of Japan. It executes all important decisions of the Raw Silk Association of Japan, such as curtailment of production, or increased production of raw silk, or enhancement of wages, etc., to workers, and in fact all matters decided upon by the Raw Silk Association of Japan. It aims at mutual friendship, removal of defects in the reeling industry, to improve financial and other resources, to unify cocoon quality, to carry on research work in reeling, to train workers, to protect them, to hold competitions, to honour them, to bring to notice of Government important matters regarding the industry, to furnish information to Government. This is a very important guild. It is desirable to have a guild of this nature in Mysore at least for the "Domestic Unit" owners so as to bring them closer with a view to find out suitable markets and to act in co-operation.

(10) *Cocoon Drying Guilds*:—With a view to increase and improve trade in conditioned cocoons, Government have been encouraging formation of these guilds in all prefectures. Each prefecture has one union of such guilds which exist one in each county. Some of the prefectures have gone ahead and already established the full number of such guilds in their jurisdiction. Others are following suite. Government contribute 4/10 of the costs of installation of cocoon drying machinery and cocoon store houses, which are ferro-concrete, rat, fire, and moisture proof buildings. On an average, Government have been contributing about Y. 30,000 (*i.e.*, Rs. 45,000) per guild. Membership of these guilds is open to all sericulturists or to persons of independent means.

In Mysore such a guild or organization to introduce cocoon drying and conditioning, and trade in "Conditioned Cocoons" is necessary for obvious reasons.

A separate regulation has been passed recently in Japan on the subject.

(11) *Guild for Improving Cocoon Spinning*:—The Filature Guild generally finances this guild. The work of this is to improve spinning of cocoons.

Co-operative filatures will be dealt with in reeling. There is an association of experts of various guilds. It aims at improvement of sericulture and research into various subjects connected with the industry.

All phases of sericultural industry are well represented in co-operation. This has considerably facilitated spread of knowledge in all branches. Researches and other benefits reach these bodies easily and spread out, matters of importance are well discussed and measures adopted. The guilds have, in fact, been institutions responsible for a good deal of improvement in sericultural activities.

Raw Silk Association of Japan.

This association came into existence in 1914, and is organised under the Law of Important Products Same Profession. Membership is open to guilds and not to individuals. Its members are filature, seed-makers', silk and cocoon brokers' guilds, *i.e.*, guilds which come under the denomination of "Guilds of Important Products Same Profession." Some rearers' societies that come under the above are also members. Its total membership is 130. Each guild elects its representative as its mouthpiece. The component guilds subscribe on a graduated scale. 30 per cent of the total expenditure is charged to all the component guilds equally, 55 per cent is charged to filature guilds, and 15 per cent is charged to seed-makers' guild. The payment by a seed-makers' guild is in direct proportion to the quantity of seed produced. The aim of this association is to promote mutual friendly relations among its members, to enlarge exports of raw silk, and to increase profits of sericulture. Its work is removal of defects in the industry, to find out methods for improvement of sericulture, *suggesting new law and regulations concerning Sericulture to Government* (including subsidies and subventions), attending to all queries from Government, keeping friendly relations with similar bodies in foreign countries, guiding its component guilds in work, to arbitrate in matters of dispute, to take all such steps that are calculated to improve the sericultural industry of Japan.

This association has a President (generally a prince of the royal blood), and three Vice-Presidents, 30 Committee Members, Secretary 1, Manager 1, Assistant Manager 1. Except the President, all are elected. One of the Vice-Presidents is in charge of all the work in the office. Some of the above officers may be paid. Apart from representative and executive committee members, the association has consulting members who are elected from among the exporters of raw silk and filatures, etc. The association has a capital fund of Y. 500,000. The President is authorised to spend Y. 20,000 annually, but the amount has to be re-imbursed before the end of the financial year. This association has no branches. Its work in the prefecture is carried out by the component guilds. The association sends out delegations to foreign countries for investigation, study, and to improve trade relations. It is a very influential organization, and its decisions are mostly upheld by Government and acted upon.

The recent grant of a subvention of Y. 3,000,000 to subsidize filatures to meet the losses due to heavy fall in prices was due to the recommendations of this association.

Sericultural Association of Japan.

The jurisdiction of this association is all Japan, and was established in 1893. Membership is open to all individuals engaged in any one of the branches of sericulture. Members are of three kinds, *viz.*, (1) Honorary members—They are elected from among the Imperial Household. (2) Special members—Those that contribute Y. 50·00 at one time, or benefactors of the Association, or men of particular experience. (3) Ordinary members—Those that contribute Y. 3·00 at a time. *No member has to pay any recurring annual subscription.* There are now, one honorary member, 10,452 special members, and 257,372 ordinary members, bringing the total to 267,824 members.

Officers:—One Honorary President, one President, two Vice-Presidents, two Superintendents. These are elected by the trustees (25 in number), who are themselves elected in a general meeting.

Branches:—There are 44 branches in 44 prefectures. The Branch President is the prefectural Governor.

The work of the association is divided into five branches, *viz.*, (1) Association work, correspondence, employment matters, (2) Financial, (3) Department of periodicals and memoirs, (4) Investigation department, (5) Expansion department, which holds lectures, Cinema Film shows *re.* sericulture, arranges exhibitions and competitions, etc.

Periodicals:—The association publishes two periodicals, one a monthly, containing literature, etc., on sericulture, the other "Light of Sericulture", containing literature regarding practical matters. The latter is published in 23 branch associations also. The branch associations under the Governor have a clerk or two to do the work of the association. Generally, this clerk works under the directions of the sericultural officer.

The work of the association consists of researches into sericulture, spreading sales of Japanese silk in the world, co-operation with other bodies, honouring of benefactors of sericulture, holding of competitions, lectures, shows, etc., improving co-operation in the industry, publication of periodicals, etc., other matters relating to the improvement of sericulture.

The society has three committees co-opted with it, *viz.*, technical committee, correspondence committee, encouragement and subsidy committee.

There is a general meeting every spring. It has its estates and securities to the extent of over half a million yen. Its expenditure is met from the interest on its securities and estates which are the result of several subscriptions as already stated. There is an Imperial donation which is kept as a separate fund. The work of the branch societies is to raise new members, to have a directory of members together with their domiciles, etc., to spread out society's publications, getting contributions, etc., assisting and guiding bodies engaged in sericultural work, researches and statistics, opening of competitions and exhibitions. The central association may give subsidies to branches which do good work. A branch society may have experts for various works.

The association may receive subsidies from Government and distribute to rearers' guilds according to merit or special circumstance.

The Mysore Silk Association has necessarily to combine in itself the functions of Raw Silk Association as well as of Sericultural Association.

Mulberry and its Cultivation.

There are 24 species and 1 variety of mulberry. Geographically it has four groups of—(1) China, Chosen (Korea), Manchuria, Japan, Malaya, and Northern India, (2) Central Asia, (3) Western Africa and (4) America .Its distribution lies between 50° North Latitude to 10° South Latitude. Regionally it is tropical to sub-tropical.

Japan has over five hundred varieties. Of the five hundred varieties only 22 are considered to be very good in Japan. These varieties are called "Encouragement varieties," *i.e.*, varieties which Government encourage farmers to plant in preference to other varieties, and have been selected with special reference to local climatic conditions, economic and other advantages. All these varieties are not "Encouragement varieties" all over Japan. A few are advised for each prefecture. Some of them are universal.

Besides the above, a few more newly evolved varieties in the Imperial Station are coming into vogue. Some of these varieties are suitable for branch-feeding of silk-worms which is coming into vogue, and in some districts it is already the prevalent method in spring season. Some varieties are early and some are late, some are suited to rocky soil and some are cold resisting, and some *draught resisting in Japan.* The most important work done in respect of mulberry from an industrial point of view is to have selected advantageous varieties.

Propagation.

There are four methods, *viz.*, seedling-planting, graft-planting, layering and cutting. Cutting-planting, which is the universal method in Mysore, is almost out of vogue in Japan, as plants got out of this system are poor in several respects.

Layering.

This system is yet common in Japan. There are various methods of layering. Chiba system in which branches are bent at an acute angle is fruitful of good results as it gives good plants.

Grafting.

This is the more modern and fruitful method. Roso is generally employed for "Stock."

Seedlings.

These are raised mostly for grafting work. Out of a total of about one billion mulberry plants produced annually, 80 per cent are grafts, and the remaining are from layering and other methods.

Mysore has too long been following the "Cutting-Planting" method which is the worst that could be thought of. This method should be displaced by seedling-planting, and subsequently by grafts when sufficient work has been done on finding out suitable grafts for Mysore. Grafts are suited for warmer regions. It is even so in Japan.

(*N.B.*:—The enormous quantity of grafts, etc., is produced in Japan by about 30,000 mulberry nursery-owners, each producing on an average about 20,000 to 40,000 plants. Very rigorous tests are conducted before grafts or seedlings are allowed to be sold out. Each plant is examined for its general health, injuries, height, and thickness. If all tests are satisfied, the planter is allowed to sell them after attaching the necessary certificates. This examination is conducted by an expert of the "Mulberry Nursery Guild." The guild determines the various tests according to standards prescribed by the Experimental Station. The moriculture expert of the district is always on advisory board. Those that violate rules and regulations of the guild are fined heavily. Of late, much vigilant supervision is exercised over this branch of the industry recognising the great importance the mulberry cultivation has.)

Methods of Grafting.

The methods adopted are "scion grafting," root grafting, bud grafting, etc. The commonest method is Scion grafting. In Mysore all methods have to be tried before adopting any particular method, as there is considerable difference in climatic conditions between here and Japan.

Systems of Cultivation.

All the three systems, *viz.*, Tree, Middle, and Bush, are in existence. Tree system is adopted in colder regions, such as North and North-Western Districts. Middle system is common in hilly regions. Bush is the commonest, and forms about 85 per cent of the total area under mulberry. In warm regions it is advantageous to have "Bush" cultivation. Trees are prone to pests. Tree leaves are superior in quality. The "Tope" system of Mysore has undoubtedly a great economic and climatic advantage.

Farms.

There are gardens for spring crop only. Gardens for spring and autumn crops only, gardens for spring and autumn, and gardens for spring and summer only. There may be gardens for chawki and mature worms separately. In the south, usually spring and autumn, or spring and summer gardens only are cultivated. In the north, the system differs. *What is necessary and important is to see that too many crops are not harvested, as that affects the vitality of the plant and is also a false economy. In Mysore it is necessary, at least in irrigated gardens, to standardise the number of crops to be harvested. Actual experiments have to be conducted before definite scheme could be given.*

Rotational Method.

This method is practised in certain areas. Mulberry is cultivated for 10 to 15 years, uprooted, vegetables followed by wheat are planted, and again mulberry is planted fresh. An improvement over this method is, that after uprooting mulberry in spring, paddy is cultivated and harvested in autumn, wheat is planted. This rotation takes place for three years. Mulberry is again planted. This method is recommended for up-keep of soil fertility and to safeguard against deterioration of mulberry.

Inter-cultivation.

Mulberry is inter-cultivated with vegetables in the vicinity of cities. With high forms of training just as the "Tope" system in Mysore, it yields double results.

Planting Methods.

Planting is generally done in spring season. For the plant, *physiologically* planting would be better in autumn season. Usually, in "Bush" system, plants are 2′×5′. The rows are always north and south. Closer plantation is not done, as it is inconvenient of management, open to attacks of diseases, and leaves ripen early. Besides, the yield of leaf is in no way more; the quality of leaf is undoubtedly inferior. On an average, per two crops per acre, when the number of plants is 1,500, 3,500, and 9,000, the respective yields are 6,000, 6,000 and 6,500 lbs. It is necessary to conduct experiments on this subject to *demonstrate* to raiyats to abandon close planting as is usually done in irrigated gardens in Mysore.

While planting cuttings, it is desirable to have vertical planting, and not slanting planting as is done in Mysore.

Training of Mulberry Plants.

One is the tree system and the other is pruning system. The former is adopted in northern regions which are cold and where rearing is not intensive. It is open to attacks of insects and pests. Its leaf is of superior quality. Some

seed-makers use this method. The latter has many modes, *viz.*, Hand and No-hand systems. In each there are four methods, *viz.*, bottom pruning, middle pruning, high system, and Chinese type. Bottom pruning is adopted in regions where there is no snow. Pruning is a systematic work and not a reckless operation. Great care is bestowed while pruning. The very instruments here will have to be changed. This subject (*i.e.*, training of trees) is of great practical importance and a number of experiments have to be conducted to select the most suitable ones for our "Bush" and "Topes." The "Akita system" which is suited to warm regions may be adopted here. Some old trees of this system produce as large a quantity as 5,000 lbs. per two crops. The average is about 1,000 lbs. per year. The Nagura method gives very large quantity of leaf in which a large number of branches is trained against a small number of branches in the "Akita system." The quality of leaf is very poor.

Quantity of Leaf per Acre.

(*For two crops per year.*)

This varies according to region. In the northern part, it is about 4,500 lbs. per acre, in the central regions about 6,500 lbs., in western districts it is 7,000 lbs., in the south it goes up to 12,000 lbs. According to variety, it may range from 10,000 lbs. in Hikujiro to 16,000 lbs. in Kasuga.

Cultivation.

In the beginning of spring, farm is dug and levelled; in the beginning of summer the "Hands" are covered, and sloping furrows are made between the rows of plants. In autumn, soil is again levelled, and in winter "Hands" are exposed to the cold. Plough is very rarely used. A shovel pick-axe with a long lever is worked by hands and feet. This is an inconvenient instrument for our workers.

Manures Used.

Manures used depend upon the soil and the number of crops to be harvested. *As a rule, mixed or rotational system* is adopted. The farms are well manured. Usually manure costs up to 20 per cent of the total expenditure on garden. In a typical volcanic region this rotation is followed.

Winter Manuring:—2 tons of compost per acre, contains 20 lbs. of N_2O, 10 lbs. of P_2O_5, 15 lbs. of K_2O.

Spring Manuring:—300 lbs. of human excreta, contains 8 lbs. of N_2O, 1½ lbs. of P_2O_5, 10 lbs. of K_2O. Plus 225 lbs. of Soya Bean Cake, contains 15 lbs. of N_2O, 2 lbs. of P_2O_5, 1·5 lbs. of K_2O.

Summer Manuring:—1,600 lbs. of human excreta, contains 70 lbs. of N_2O.

Totals, contain.—115 lbs. of N_2O, 57 lbs. of P_2O_5, 100 lbs. of K_2O.

For alluvial soils, the following recipe is one of the many used. 2 tons of compost, $\frac{9}{10}$ ton of human excreta, 4 cwts. of Soya Bean Cake, and 2 cwts. of Superphosphate of Calcium. In mountainous regions, one of the recipe used is $\frac{1}{4}$ ton human excreta, $\frac{3}{10}$ ton of calcium oxide, $\frac{9}{80}$ of a ton of Soya Bean Cake, 180 lbs. of Superphosphate, $1\frac{1}{6}$ tons of silk-worm litter per acre per annum. In a sandy soil one of the recipes used is Compost 2 tons, Soya Bean Cake $1\frac{1}{4}$ tons, Superphosphate 40 lbs., Human Excreta ½ ton, Green Manure 1 ton.

Experiments in favour of mixed and rotational systems have to be conducted. It will not be practicable to prescribe one general formula for all regions and for all kinds of systems of cultivation in Mysore, *viz.*, for *Khushki* and for *Bagayat*.

Use of fertilisers on a large scale is not yet common in Japan.

Mode of Picking of Leaves.

Great care is bestowed while picking leaves. The axillary buds are allowed to remain in tact. Single leaf picking is adopted, for picking leaves in chawky stages. A finger nail of a particular make is used with great advantage for picking leaves on a large scale. This method may with advantage be adopted here. For "branch feeding" of worms, branches are cut entirely, and subsequently the garden is given a "Dress cutting" to remove the defects caused therein.

Preservation of Leaves.

Great care is taken in storing leaves. Badly stored leaves, means indication of "Flacherie" in the worms. Generally Government institutions and some seed-makers have an under-ground cellar attached to one of the "rearing" buildings. This cellar is about 15′ × 10′ × 9′ in concrete and cement. Leaves can be preserved even for two or three days without deterioration in quality. The construction of such cellars in a hot country is even more imperative. Even the ordinary rearer takes great care in preserving leaves.

Hybridization.

This work is difficult with mulberry, due to difference in time, in appearance of male and female flowers. Pollen lives for 60 days and can be preserved for 16 days without loss of vitality, but stigma dies soon, and often the female flower blossoms earlier. When female flower blossoms later than the male, cross-fertilisation could be effected. Before doing any cross-fertilisation work in Mysore with Japanese varieties, it would be necessary to study the varietal characters and behaviour of each in several respects. This work is not only important, but also absolutely necessary. More land would be necessary for this work in our gardens.

Farmers' Gardens.

It is very rarely that a raiyat in Japan, plants cuttings. He uses grafts or layers. Plantations are not close, pays great regard to up-keep of soil fertility by using suitable quantities and varieties of manures, harvests less number of crops, allows the plants to develop well between crop to crop, prunes the garden with great care, which is absolutely lacking in Mysore on the assumption that mulberry stands any bad treatment.

Diseases.

The list of diseases of mulberry in Japan is long. Some of these are trunk, some leaf, etc., diseases. Remedial measures are few, and where they exist they are uneconomic. Against, "Brown Spots" on trunk, there is a preventive measure, *viz.*, application of coal tar and soap solution. For the bacterial disease of leaves no remedial measure has yet been found out. Mumpa disease is very common. Prof. Miyake's treatment is use of Chloropicrine in the soil. The results are very good. The cost of treatment is fairly prohibitive to a raiyat. For root-rot no remedial measure has yet been found out. The cause of dwarf disease has not been fully understood. It is due to physiological disturbances, resulting from cutting off shoots too often. There is absolutely no remedial measure against it. Preuention consists in not cutting the plant too often. Frost injury is common in Japan. Septogloem Mori, which is seen in Mysore also is common in Japan. No economic remedial measure has yet been found out. Mildew is not so common in Japan. Satisfactory remedial measures have not yet been found out.

Rearing of Silk-Worms.

In rearing the first important requirement is a suitable rearing house. In Japan rearing houses are standardised in all Government Institutions. They generally run east and west, and are ordinary Japanese style buildings, which are as a rule built of thin mud walls, outside being covered with wooden planks. The length of the house is between 60′ to 80′. The whole building is divided into 5 to 7 rooms of uniform dimensions. The rooms are separated by a thin wall and have wooden plank ceiling and there is a tiled roofing above it. The second story is used for stocking materials and also for use during mountings. All the rooms on either side have sliding doors in wood and paper for the full width of rooms. Lengthwise on either side of the building there is a verandah of about 4′ width, provided with half glass and half wooden sliding doors, so that when the sliding doors of the verandah and the sliding doors of rooms are opened the whole building (first floor) becomes a completely open house. There is a pit 3′×2′×2′ made of plaster in cement provided with a plank shutter and side chimney for draft in the centre of each room. During the spring season fire can be put into it and the room kept at the required temperature of about 80°F. Each room has one or two draft chimneys from the plank ceiling up into the air. The top of this draft chimney has a revolving fan which moves on a pivot-socket arrangement and responds to motion of air. This chimney can be shut by means of a shutter when not required. Due to the revolving fan on the top of the chimney air inside the room is drawn out. Thus, all vitiated air is driven out, and the room is kept in a hygienic condition. This arrangement is simple and deserves to be introduced in Mysore.

In summer season a reed "pent" is put up on either side to keep the rearing rooms quite cool. The arrangement though simple provides for hygienic conditions necessary for rearing of silk-worms. This type of rearing house has with great advantage been adopted in Central China Institutions and also in the South with great success. This type of rooms can with advantage be built here. The rearing house has always an underground cellar for storing of leaves, and one wing is extended to admit of holding office for the staff.

Some institutions have special rearing houses for physiological, bacteriological and genetical work. In such houses humidity and temperature are controlled by means of temperature and humidity controlling apparatus. Generally *ammonium plants* are used for regulation of temperature. The general plan of the house is the same as in the first case, but the buildings are in "Ferro-Concrete." Ordinarily a building with all machinery necessary for control of humidity and temperature may cost about Y. 60,000·00. Provision is generally made in such cases for having a cold storage for "Hibernation" of silk-worm eggs and keeping mulberry cuttings. This feature is a growing one in the institutions in Japan. *Especially, genetical work has no real scientific value as in quantitative characters, without the control of environment.* No one can definitely find and explain the causes that operate, since so many characters in genetical work in sericulture are quantitative. The imperative need for having temperature and humidity controlled chambers has been practically recognised, and more additions are annually being made in all prefectures.

The raiyats' rearing houses in Japan are simple, Japanese styled houses where they live. The rooms have card board sliding partitions, and this enables them to increase the dimensions of the rearing houses whenever necessary. For heating in spring season ordinary braziers are used. Ventilation is easily adjusted by means of the sliding doors, and by installing roof revolving draft chimneys. In a word, full regard is had to all hygienic conditions in the rearing houses.

The seed makers' rearing houses are of the ordinary above type. But, many Seed Rearers prefer to have rearings in the second story of the building especially during summer. For controlling humidity some seed makers now-adays freely employ adosol (volcanic earth) which is hygroscopic. Rearing houses are supplied with air that is forced through an adosol supply by means of a fan worked electrically. For regulating temperature ordinary braziers are used. Some joint stock companies which are filature owners like Gunze, Katakura, etc., produce seed on a large scale. Such companies generally have rearing houses of the type usually had in Government institutions.

Appliances.

Generally a stand is of about 7′ in length and 2½′ in width, and 8′ to 9′ in height. It is made of ordinary wood with removable bamboo bars. The distance between tiers is about 9″ to 11″. On the whole, the s are simple, cheap, with *proper space* between tiers, and are handy, and co ent in handling trays. Sometimes, special kinds of stands are devise special work.

Trays:—These are made of bamboo, are rectangular in shape and convenient to handle. The ridge is either full bamboo or half "Splits ground is of thick 'splits,' woven into lattice of a special design, the raised is entirely wanting in. In size they are 3′×2½′. For chawki rearing, box s is coming into vogue. These are of either zinc or card board and may be 20″ and covered with a lid. This arrangement does well for a chawki re Bidadi rearers are in the habit of confining chawki to brass plates and cover tight. This method may be modified into the more scientific one as in Jap

Nets:—These are very freely used all over Japan, as they *facilitate cle work*, and *are very hygienic* as against hand cleaning and transfer of worms the tray a mat woven of reeds is employed over which generally paper is s Worms are fed on this, and before cleaning net of suitable size is spread and worms are fed twice or so, and the whole net with worms is transferr another tray. Thus, one net is practically left in the tray. Nets are of s meshes which, of course, vary according to the age of the worms. These are of fibre, and two opposite sides are held in split bamboo. For advance worms nets are made of paddy straw. The use of nets can be adopted in M with advantage. Manufacture of nets can be started in the houses of sericult as a subsidiary occupation.

Stands for Changing Beds and for Feeding:—Small X type collapsible s are used for the above purpose. Their use in feeding enables feeding to be standing, and allows it to be done more hygienically than in ordinary These will also have to be used here.

Mountages:—Various methods are adopted for mounting of worms. best are V type collapsible ones. These occupy very little space when not i Worms can find suitable places in the Vs for spinning. There is perfect ve tion, and good cocoons are spun by worms. These can be spread in the ord trays when worms are to be mounted. Ordinary twigs are also employed in places. Another kind of mountage in use is made of paddy straw which is into thin bundles of ten to fifteen straws and bent into contiguous Vs, whic arranged into parallels on the bed of a tray. The cocoons spun are good since they cannot be re-employed, and involve labour for each crop their u becoming less. But, where labour and paddy straw are to be had cheap serve the purpose well. Centipede mountages are also in use.

Knives and Chopping Boards:—Knives are of steel, and are thin and b The sizes vary according to the size of leaf to be cut, etc. What is importa that the knives should cut 'True,' and should not 'Express' juice out of le Mechanical arrangements for cutting leaves are going out of use as 'B feeding' is coming more and more into prominence. Boards are square, thick and of fairly hard wood.

Dry and Wet Bulb Thermometers:—The use of these instruments is common. Of late direct humidity reading set is used as it facilitates work. humidity and air conditioned chambers there are automatic recorders, and c vances exist for automatic regulation of temperature and humidity. The u thermometers, etc., will have to be popularised at least with seed-cocoon prod

Baskets, Etc.:—Baskets for holding leaves at feeding time are essentia are made of split bamboo of a convenient size. Pressed card board plate used for "Chawki" leaves.

Charts, etc.—In all Government Institutions for ordinary rea standardised charts are maintained for rearing spring, summer, and autumn with reference to humidity and temperature. Feeding, cleaning, and operations are also regulated according to these charts.

Material for Cleaning:—Paddy husk is almost universally used for its obvious advantages. Now-adays in experimental stations 'Charred husk' is more freely used instead of raw husk. In branch feeding calcarious (powder) earth is used, though no cleaning is done. This is done to prevent muscardine, as these rearings are had in open rooms or barracks.

Feeding and Spacing:—The number of feedings varies according to age of worms and season. In the spring season from 1st to end of 3rd age, worms are fed 6 times a day, and properly 'sized-cut' leaves are fed. From the 4th age onwards the number is reduced to 4-5 times a day, and the worms are fed entire leaves. In summer and autumn crops the number is increased according to temperature, etc. The feedings are all done following the fundamental principle, *viz.*, that of "Appetite" and "Appetite Curve" which varies according to environment and the period in each age. The number of feedings in Japan per day is comparatively less, for three reasons, *viz.*, the temperature is low, leaves are thick, and leaves do not dry soon. Great care is taken in feeding uniformly in the trays, which are comparatively of a smaller dimension and as such admit of better feeding. Spacing between tiers has already been referred to. Worms as a rule in a tray are *thin and evenly* spread out. Overcrowding of worms is never to be seen in Japan, which is one of the sore points in Mysore rearings. Ordinarily in experimental stations, etc., worms are reared "Cellular", *i.e.*, worms of individual moths are separately reared. Consequently there is more space. In raiyats' rearings chawki of a 100 layings usually occupies 1½ to 2sq. ft. which gradually increases to 150 to 200 sq. ft. at the end of the rearing. The importance of proper spacing cannot be emphasized too much.

Methods of Rearing:—"Cellular" method is adopted in experimental work, and in producing "cellular seed." In experimental stations for producing "original seed" for use of seed makers and for use of station, generally worms of two moths are reared together in a tray. This cellular method is costly, but is very scientific as it facilitates easy elimination of diseased batches. *It would be necessary in all Government farms to minimise the size of trays and rear worms cellularly in the interests of improving the quality of rearing.* This would in the beginning increase costs on mulberry leaf, but it would be of great advantage in the end. *Seed-makers adopt the cellular method or more especially rear worms of 2 or 3 months together.* Village rearers generally have combined rearing of worms of 5 to 6 moths per tray as this is more *economic.*

"*Josoiku*":—This is the branch feeding, and it consists in feeding entire cut branches instead of entire leaves after the 3rd stage of worms. The rearing house may be the ordinary house of the raiyat, or a barrack, or a pendal put up in an open space for the purpose. On a raised platform of about 2′ in height, trays are arranged from 6′ to 12′ in length, and 2′ to 3′ in breadth. Such trays may be contiguous, and to the length of the entire room. Usually there is no tier above tier as it is very inconvenient of handling. Cut branches are arranged in trays and worms sprinkled over. Worms are fed once or twice a day by arranging branches. This sort of feeding continues till the worms mature. No changing of bed is done during the whole rearing period. This method is very economic as it spares labour in feeding of worms, and picking of leaves. The average harvest for 100 layings is 100 lbs., and in better grade rearings 125 lbs is not unusual. Experiments in this method of rearing are necessary in Mysore

Rearing according to Method of Feeding:—Of the several methods in vogue, cut leaf feeding is the best. The worms in this method are fed with cut leaves from hatching till the end of 3rd or 4th stage. This method is costly. In the second method young shoots picked from the bushes suitable for chawki worms are cut into small pieces of 5″—6″ in lengths, and arranged across in the trays containing worms taking care that all leaves are spread out properly, and the next feeding is given after all leaves have been eaten up by the worms. Leaves do not dry soon, and the number of feedings can be minimised. In the third method the shoots are even longer and keep in "condition" longer.". This is a very economical method. But skill is necessary in arranging shoots, otherwise young worms remain under bed and are lost. According to recent estimates full shoot and cut shoot methods during chawaki have gone up to 40 per cent of the total rearings Branch feeding during advanced ages is used by 60 per cent of rearers in spring

season all over Japan. In Saitama Prefecture it is 90 per cent in spring season. In summer and autumn, the percentage is very little. On an average, worms of 100 layings occupy about 150 sq. ft. space in the advanced age. Roughly with reference to quantity, there is a difference of 6 to 10 per cent only between this and the ordinary rearing. *This is more than balanced by the considerable reduction in expenditure.* Experiments are being conducted on a large scale to have worms reared outside of houses, and also on bushes in the mulberry garden itself. Results cannot yet be said to be satisfactory.

Essential Statistics of Rearing:—On an average each rearer rears worms of about 9 egg cards (one egg card contains 28 layings), produces about 350 lbs., of cocoons. 150 kwan of leaves give 10 kwan of cocoons (1 kwan=8·27 lbs.) which give 1·00 kwan of silk. 80 per cent of rearers carry on rearing as a subsidiary occupation, and 20 per cent as a large scale industry. Of the total number of persons engaged in the industry, 66 per cent are women, and 34 per cent men. Altogether there are 19,700 rearers' guilds with a membership of six lakhs. Most rearers have their own gardens, about 6 to 10 per cent purchase leaves. *It is very uneconomic to purchase leaves and rear excepting in the case of seed cocoon rearers.*

Seasons for Rearing:—There are three rearings a year *now* in Japan as against only one in former days. This has been possible as a result of "Artificial Hatching of eggs." The first rearing is the spring rearing. Eggs hatch about the first week of May and crops are harvested in June. This crop is mostly of univoltines and a small quantity of bivoltines. 99 per cent of rearings are first generation of cross-breeds and are of previous year's crop. Eggs are subjected to cold storage from February to middle of April. A small percentage is yet hatched without "cold storage" operation. In this case hatchings are irregular. The average temperature in rearing houses is 70°F. and highest 78° F. and lowest 65° F., the average humidity percentage is 75, and highest is 94, and lowest 50. Spring crop forms 50 per cent of the total crops.

Summer Crop:—Eggs hatch by about the 25th July and harvests are made between the 15th and 20th August. 50 per cent of the eggs used for summer crop are from previous year's *hibernating eggs* submitted to cold storage from beginning of February to the beginning of July. 50 per cent of the eggs are from eggs of the same year artificially treated. Summer crop forms 30 per cent of the total crop. Use of eggs of same year, and with artificial treatment is becoming more and more common as against use of previous year's eggs.

Autumn Crop:—This crop forms about 20 per cent of the total crops. 5 per cent of eggs are from spring seeds of bivoltines submitted to cold storage till the end of August. These eggs are *deposited* in cold storage 50 hours after laying. 95 per cent of eggs are from summer crop as cold storage of layings of previous year would be too long and useless for practical purposes. The above eggs are subjected to cold storage 40 to 45 hours after laying, and kept for 20 to 70 days at a temperature of 40° F. Eggs are removed between 20 to 70 days at the desired time and treated artificially. In 10 days after treatment eggs hatch. The average temperature in rearing house is 82° to 83° F., highest is 88° F. and lowest 75° F., and respective humidity percentages are 80, 90, and 50.

Varieties, Etc., of Silk-worms:—The number of varieties, etc., of silk-worms in Japan was too much. The first step that Japan had to take was to reduce the number by process of elimination. Even the existing list of varieties is fairly long. The most important ones that are in common use are as follows:—

Spring Univoltines:—

(1) Japanese:—Nichi$_1$, Nichi$_{10}$, Matamukashi.
(2) Chinese:—Shi$_4$, Shi$_5$, Shi$_7$, Shi$_8$, Shi$_{13}$.
(3) European:—O$_7$, and O$_{10}$.

Summer and Autumn:—

Japanese:—Nichi$_{101}$, Nichi$_{107}$, Nichi$_{110}$.
Chinese:—Saihaku Shi$_{105}$, Shi$_{102}$, Ho, and En.

The several important cross breeds are for spring Nichi$_1$ × Shi$_4$, Shi$_4$ × Shi$_5$, Shi$_7$ × O$_7$, Shi$_{18}$ × O$_{15}$. White varieties are more in vogue than yellows.

Summer and autumn crosses are Nichi$_{107}$ × Shi$_{8}$, Nichi$_{107}$ × Saihaku Shi$_{105}$, Nichi$_{110}$ × Shi$_{102}$, Ho × En.

Comparative essential data of the above races :—

Name of variety	Total period of rearing.	Colour of chawki	Colour of mature worm.	Percentage of double cocoons.	Weight of 1 litre of cocoons.	Quantity of silk per cocoon.	Length of silk filament (average).	Average Denier.
					Grs.	Grs.	Revolutions.	
Nichi$_{1}$ ..	31	Black	Reddish	6·2	187·5	·213	608	3·12
Shi$_{4}$ ..	29	,,	Bluish	3·6	139·9	·202	602	3·02
Shi$_{5}$ ..	29	,,	,,	2·6	150·5	·217	607	3·00
Shi$_{7}$ ..	30	,,	Reddish	2·9	166·0	·229	632	3·05
O$_{7}$ ..	32	Brown Black	,,	1·8	160·6	·239	659	3·01
Nichi$_{107}$ ..	23	Black	Bluish	9·8	171·0	·143	469	2·71
Nichi$_{110}$ ..	22	,,	,,	13·1	158·0	·145	469	2·78
Shi$_{101}$ ..	29	,,	,,	12·1	108·0	·145	520	2·70
Shi$_{102}$ ..	20	,,	,,	6·2	145·0	·137	475	2·64
Saihaku$_{105}$	20	,,	,,	5·4	127·0	·147	489	2·83

It is seen from the above that univoltines are better than bivoltines in several respects. The denier of the several breeds is "thick," and is very inconvenient in producing 14 denier silk which is the requirement of the United States of America.

Seeds of original races are prepared by the prefectural experimental stations to the extent of 25 per cent of the total demand of seed-makers, and the rest are prepared by the seed-makers themselves. The Imperial Sericultural Station evolves new breeds and distributes a small quantity to prefectural stations which multiply it, and distribute to several seed-makers.

Cold Storages, Artificial Hatching and Incubation of Eggs.

Technically speaking systematic cold storages, and artifical hatching have been two essential boons in the sericultural industry of Japan. In the old days eggs were used to be submitted to cold storage operations by depositing large quantities in ice-caves called "Fuketsu" which are to be found in many places in Japan. Mount Fuji caves were famous for this. Cold storage in olden days cost practically nothing, but the variations in temperature remained uncontrolled, and the conditions varied from place to place. Gradually this was abandoned to a more favourable type of cold storage. The Inspection Stations in counties construct a cold chamber of ordinary wooden planks, double walled, and with double walled chambers whose walls were filled with saw dust, cork, and other non-conducting material. The outer double wall of the chamber is filled with ice in season. Between the ceiling of the chamber and the tile roof, ice is packed in saw dust. The inside chambers are used for storing eggs of not only the stations, but also of seed-makers. The temperature obtained does not vary as much as in "cave" (Fuketsu). All the seed-makers keep the seed in this chamber under the management of their guild, subject to control of the Seed Inspection Station. The charges are borne by the guild, and the members have to pay a graduated sum according to the quantity to be stored, period of storing, etc. Even now, these cold storages are in existence. Of late, the tendency is to have ferro-concrete buildings with ammonia plants. This is the best type as temperature can be regulated. Results are therefore very satisfactory. *Such a cold storage would be absolutely essential here* for two reasons, *viz.*, we could conserve eggs of grainages, and distribute them when there is demand, which would place the grainages on a sounder basis, avoiding uncertainty: and it would enable us to carry on genetical work scientifically in silk-worm races.

Generally eggs are confined to cold chamber in the beginning of February in Japan, the temperature being 34° F. till the middle of April for spring varieties, when these are removed and incubated according to standard methods. As regards summer varieties, cold storage starts in February and continues till the beginning of July, and in the case of autumn crops (only 5 per cent are treated like this) the cold storage continues till the end of August.

In conserving eggs, it is necessary to know the *particular period of the embryo in the egg.* In the univoltines and bivoltines it is the resting period, and this embryonic stage lasts from middle of December to about middle of January. Bivoltines for rearing in summer are kept in cold storage till the end of May. The eggs are then removed, kept at 60° F. for 3 days and subsequently at 65° F. for 2 days. The embryo attains the maximum *length period.* The seeds are again confined in cold storage till they are required for incubation. This may be termed the "duplicate system" of cold storage. This is a very important method in the treatment of eggs.

Artificial Hatching:—The several important methods by which eggs can be artificially hatched are treatment by hot water, treatment by Hydrochloric acid, and electrical method.

Hot Water Method:—This is perhaps the oldest having come from China. Even to-day it is common in Kwangtung. The eggs to be treated after preliminary process are dipped in hot water at a temperature of 110°—115°F. for 4-10 seconds according to voltinism, period after depositing, etc. This method though simple and economic, is not so good as Hydrochloric acid method.

Hydrochloric Acid Method:—This is the commonest method now in Japan. Eggs to be treated, after preliminary processes are treated in Hydrochloric acid of 15 per cent strength at 115°-120° F. for 5′-10′ according to voltinism, period after laying, etc. In Inspection Stations, and in grainages, arrangements are made for hot water jackets in which celluloid tubs containing hydrochloric acid of the required strength are held semi-floating. The egg cards are all held in a frame, and the entire frame is immersed in the celluloid tub when the required temperature is got. In companies like Fukyusha and Gunze, thousands of egg-cards are treated in a day. This method is both economic and simple and gives very satisfactory results in hatching.

Electrical Method:—Of late, this method has been perfected. 99 per cent of eggs electrically treated, hatch and give satisfactory results in rearing. Egg cards are held in hollow metallic cylinders provided with discharging needles. High pressure pulsating current is passed for about 6′-8′. The one great draw-back of this apparatus is that it is too costly—standard set costing as much as Y. 1,200·00 besides costs of erection. Otherwise, it is satisfactory, and it is neater in operation than the hydrochloric acid method. Kyoto College has perfected this method, and is using it freely. A few seed-makers have used it successfully.

Treatment of Bivoltines:—Spring Bivoltines are treated as follows:—

(1) For use of Summer Crop.

(2) For use of Autumn Crop.

The "white eggs" are as a rule rejected, because they do not give good results. For summer crop the "Kurodane" or eggs that would turn black are selected, and treated artificially by means of hydrochloric acid, and subsequently hatched. For use of autumn there are two methods, *viz.*, the eggs are treated artificially, and 30 hours after treatment are subjected to cold storage at 40° F. for about 20 days. Then they are removed, incubated, and hatched. In the other method, the eggs are subjected to cold storage at 40° F. 40-45 hours after laying for a period between 20-70 days, and treated artificially. It is important to note that the strength of *acid used* is 20 per cent, and time is also longer.

Incubation:—Incubation is very important with univoltines and bivoltines. Univoltines removed from cold storage in the middle of April are kept in a place or chamber where the temperature is raised to 60°F. gradually. At 60°F. they are kept for 3 to 4 days and the temperature is gradually changed to 70°F. to 74°F. in the course of a week. The eggs are hatched at 74°F. Spring bivoltines are treated in a *similar way*, but, the hatching is done at a temperature brought to

77°—80°F. as at 70°—74°F. bivoltines become bad. It is desirable to have here temperature regulated chambers for *incubating* univoltines and bivoltines for use of annual rearings at least.

Silk-worm Seed and its Manufacture.

The total quantity of silk-worm seed required annually in Japan is about ninety crores of disease-free layings. Of this, about two crores are for reproductive purposes, and the remaining eighty-eight crores of layings are industrial seed. All this seed has to be examined for pebrine. This enormous work requires an organization which should not only be extensive, but efficient. Government have taken up the work of examining seed themselves by establishing Seed-Inspection Stations, whose work has already been described. The experimental stations supply "Reproductive" eggs to the extent of 25 per cent only, and the remaining quantity is manufactured by seed-makers. All industrial seed is prepared by seed-makers. These seed-makers are licensed by prefectural governors, and rigid standards are prescribed for appointing them. Their total number in 1929 was about 7,000. Each prefecture and each county has its own seed-makers. The idea that seed should be from a particular locality alone no longer exists, though some rearers prefer to have seed of particular localities, or of seed-makers. Each seed-maker on an average prepares 4,300 egg-cards (one egg-card contains 28 layings). Spring-egg cards are sold at Y. 2·00—2·50 each, and summer and autumn ones at Y. 1·00—1·50 each. Fairly big seed-makers manufacture nearly 30,000 egg-cards and earn as much as Y. 8,000·00 to Y. 10,000·00 per annum. Even small makers who produce between 3,000 to 4,000 egg-cards, earn Y. 1,000·00. This industry is lucrative in Japan as the price of layings is very high, for, the ordinary rearer knows the benefits of good seed. Some companies like Gunze and Katakura, manufacture several lakhs of egg-cards.

Usually a seed-maker rears seed cocoons for reproductive purposes himself, but seed cocoons for preparing industrial seed are reared by other rearers under him. In such cases the whole group is regarded as one concern, and the seed-maker is held responsible for all under him. The Inspection Station exercises control over both. A seed-maker who gets his seed cocoons from his sub-worker, purchases from him. In some cases share system is also adopted. There are 431 guilds and its branches of seed-makers in all. 70 per cent of summer and autumn seeds are hatched by artificial treatment by hydrochloric acid method and 30 per cent are submitted to "Duplicate Cold Storage" system.

There are three kinds of seed, *viz.*; cellular, *i.e.*, each laying being separate as in egg-cards, and this forms 79 per cent ; second is combined layings, layings of 35 or 100 moths are laid on one sheet and this forms 15 per cent, and loose seeds as in Italy form 6 per cent. The last named one may be in bags containing 30 grams or 19 grams or 9½ grams.

Sale of Seeds.

The seed-maker may sell his seed directly to rearers. This is possible when the quantity is small. He may have an agent of his own, which is possible when the quantity is large. The ordinary method is to effect sales through a broker who is a licensed vendor, and who should conform to certain regulations of sericultural law. The broker may get a commission on actual sales effected, or he may purchase seed at rebate rates and sell for himself. There are several thousand seed-brokers. They may sell at their own shop or hawk about. Hawking is prohibited in certain prefectures. Brokers in certain prefectures are required to have small ice-packed storages for conserving silk-worm seed during season to prevent seed being spoiled.

Mention has already been made of the equipment of rearing houses of seed-makers. During the rearing period the crops are examined for diseases, proper development of worms, etc., by the staff of the county Inspection Station constantly.

This becomes possible as there is adequate staff. When the crop is harvested successfully a certain percentage of cocoons is submitted for microscopic examination in the county guild. Moths from sample lots are made to emerge 3 or 4 days earlier than in the normal case. This is possible by keeping such lots of cocoons in a chamber whose temperature and humidity are regulated for that purpose. For example, when the average rearing temperature is 70°F. and humidity 75 per cent, the chamber in which " sample lots " of seed cocoons from which forced emergence of moths is desired, the temperature is regulated constantly at 86°F. and humidity to 85 per cent. This treatment accelerates emergence of moths 4 or 5 days earlier. Such moths are tested for pebrine and if the percentage is found to be more than 5, the cocoons are rejected for seed purposes. *Such small chambers for forced emergence of moths in our grainages would go a long way in effecting economy and increasing efficiency of our work.* After success in this test, the seed cocoons are all sorted. Double cocoons are removed, as also irregularly shaped and flimsy ones. Only cocoons of average uniform shape and size and of thickness of layer are retained. These operations are hand done. In rare cases size machine is used. Floss of cocoons is removed by floss-removing devices. This is used as high grade silk waste. The cocoons are arranged in trays in the usual way. Temperature is kept at about 75° to 80°F. and humidity is regulated to about 75 per cent. Where male and female cocoons are to be kept separate as in preparing crosses, etc., they are separated by male and female cocoon separating machines. If the quantity is small, males and females are separated during the larval stage. It takes 20 days in spring, and 13 days in summer for moths to cut out. Pairing is done in *dark* room. After the pairing is over, female moths are consigned to tin-rings, arranged on egg-cards or in cellules, or on sheets of paper according as the system is that of egg-card, or of cellules, or combined. After three or four days, all female moths are transferred to regulation cellule boxes which hold 28 moths in serial order, and numbers of egg-cards are correspondingly given to cellule box. The egg-cards are all arranged serially, and according to race, etc., in egg-card holders, and kept in a store room of the seed-maker, prepared for that purpose, where required temperature and humidity are had. Moths contained in the card-board cellules are all taken to the local Inspection Station, and deposited there for examination, which takes place as already described under " Inspection Stations." There are two kinds of examinations, *viz.*, percentage and cellular. In the former, 10 out of 100 moths of *industrial seed* of a particular batch, race, and of seed-maker are examined, and if the examination indicates not more than 1 per cent of pebrine, then the eggs are certified good. Should the examination give more than 1 per cent in the 10 per cent of the moths examined, then, re-examination is done. This method is adopted for moths used in preparing cards, but, in case it is combined laying system, *i.e.*, where 100 moths are made to lay eggs on one sheet, the examination is repeated, and in case the percentage of pebrine is less than 10, then the sheet is passed; otherwise, the whole lot is rejected. In the cellular method each moth is examined separately. Generally, ten fields are examined for each moth. In the egg-card system rejected layings are removed, and good substitutes are gummed. 40 per cent of the total examination is by percentage examination, and 60 per cent is individual moth examination. First examination of moths is not charged for. For re-examination, there is a small fee. Some prefectures are now contemplating to charge a small nominal fee for first examination also.

Small seed-makers generally do their own work with the assistance of their family members, employing a few girls for pairing, etc., of moths. Bigger seed-makers employ full time experts for rearing, and for preparation of seed. As a rule, the seed-makers are all trained men, and are fully conversant with technical, economic, and organization aspect of the work.

Reference has already been made as to preliminary examination of moths from seed cocoons to be preserved for making seed. In addition to this, the seed-makers in their guild get examination of eggs for pebrine. From a batch of seed cocoons used for forced early emergence of moths, 50—100 layings are taken, and from each laying 50—60 eggs are microscopically tested by the expert of the guild. Such of the batches that do not satisfy the required tests are rejected for

reproductive purposes. Each seed-maker of a guild contributes Y. 40·00 per year for expenses connected with employment of expert, maintenance of cold storage and other charges. These charges differ from guild to guild. The egg-cards, sheets, or cellules of seed-makers are all stored for check, and for certificates in Inspection Station at the proper time.

During the examination of moths in Inspection Stations, great care is taken to keep all batches of moths separately. All hygienic precautions are taken to see that mortars, pestles, slides, cover slips, are all well cleaned. There are standardised methods for each operation which ensure both economy and efficiency. Microscopic examiners are all girls who have had their training in one of the Inspection Stations. They are paid about Y. 0·70 to Y. 1·00 per day of 8 hours. The examination season lasts from August to October or November, when all of them are sent away. For a group of 5 to 6 examiners there is a supervisor, who checks the examination by inspecting 10 per cent of the work of each girl.

Reference has been made already *re*, mechanical equipment of inspection stations. Suffice it to say here that *the moth crushing machine used does not only turn out more work, but, is economic, and allows operations to be done more hygienicalty than in the ordinary method.*

Thus, the seed-making industry is a specialised branch spread all over the country and is a private enterprise under strict control of Government in virtue of Sericultural Law of Japan. It is lucrative, and absorbs men of education, technical training, and to a certain extent, men of small capital. The commercial aspect of it is regulated in virtue of issuance of vending licenses to vendors, and admits of decent profits to all engaged in that business. Moreover, seed-makers are encouraged to have such breeds as are approved by Government institutions, which have determined them to be profitable in several respects.

Silk Reeling and its Organization.

Japan till 1870 depended for reeling on old reels. The industry was mostly cottage one, and in some cases it was in the hands of small capitalists. The position was just analogous to what it is in Mysore to-day. From the figures given elsewhere, it is seen that out of a total annual production of about 9 crores of lbs. of silk, nearly 8 crores of lbs. is manufactured in filature, and about 40 lakhs of lbs. in foot-reeling and other establishments, and the remaining 60 lakhs of lbs. is double cocoon silk. Out of the total reeling establishments of about 77,000, only 925 are of 100 basins and over. The silk produced in foot-reeling and other cottage establishments is not exported for two reasons, *viz.*, that standardisation in reeling cannot be practically effected and that large quantities for export would not be available. This is one of the reasons why larger filatures producing large quantities came into existence rapidly.

Economic Types of Filatures :—In 1927, out of 2,486 concerns, 1,293 were those managed by a single individual, 68 were of family companies, 137 were of Joint Stock Companies, 494 were of Limited Companies, and 494 of Co-operative Guilds. Filatures with over 250 basins are mostly to be found in Joint Stock and Limited Concerns. Messrs. Katakura Filatures have altogether 21,000 working basins. This is the biggest filature company of the world. Limited Companies are doing good business now.

Co-operative Filatures :—This type is a new one. These are very popular in Gumma and Nagano prefectures. The members of a guild who are rearers, raise their own cocoons especially of high grade and deliver them to their co-operative filature, or the guild collects them and passes on to its filature.. *The girls of these rearers attend to reeling.* Employing of other girls is also becoming common now. This is due to restriction on age of girls to be employed interfering to a certain extent. These filatures work now almost continuously. This type of filature has some advantages, *viz.*, that it gets loans at cheaper rates, and hence costs of production become less, and moreover girls of rearers are employed on work during off season which brings them income. Cocoons are paid for according to "Index Value" of silk on market rate after actual tests. Moreover, the profits of the filature are distributed within the locality. There is

practically no expenditure on purchase of cocoons. The filature may advance money to rearers when required by them. In other cases, where cocoons of members are not paid for, payment is made after selling silk, making due deductions for manufacturing charges, etc. These filatures have between 50 to 100 basins each and very rarely 200 basins. This type of filature is not subject to such violent financial troubles as the ordinary type is. It has its disadvantage of party feeling. Attempts are being made to curtail it by all means, and it is thought that this defect would be removed sooner or later. *This type of filature is suitable especially in places where rearers find it difficult to dispose of their cocoons.*

Cocoon Markets.

Cocoon markets are as follows :—Bargain may be made at the house of the rearer. This, of course, is the time honoured method, and has its obvious disadvantages. This is comparable to cocoon markets in Mysore, but with a little difference that Yokohama Silk Exchange quotations being open knowledge to all every day, the seller is in a better position in Japan than in Mysore to safeguard his interest. This cocoon market is generally for small purchases.

When purchases are on a big scale, sales of cocoons may be effected at the filature itself. The rearer brings his harvest in a basket containing 13·3 lbs., of raw cocoons as the average sample, and on the basis of prices of cocoons as per "index value of silk content," settlement of rate is made. This "index value" has already been referred to as "Kakeme." Kakeme—this is also the price in Yen of that quantity of raw cocoons that produce 1·33 lbs., of silk. Suppose the rate per kwan (1 kwan=8·27 lbs.) of cocoons is agreed at Y. 5·00, it is understood that the filature will pay that rate, if the silk content on actual test reeling of 400 momme of cocoons is found to be 10 per cent. Should the cocoons give 12 per cent or 8 per cent, the payment is made in proportion, *i.e.*, $\frac{\text{Y. } 5{\cdot}00 \times 12}{10}$ = Y. 6·00 or $\frac{\text{Y. } 5{\cdot}00 \times 8}{10}$ = Y. 4·00 per kwan. This is very fair to the seller as well as to the purchaser. It has the minimum element of speculation. Cocoons may be paid for in due course of time according to settlement, or the filature may have it as spot transaction, and pay immediately after weighment, having settled prices, or, the filatures may purchase in open market, such as that of a guild. In any sericultural village, there is a guild of rearers, and all the rearers, or at least its members, bring the cocoons, and have the sample lots open to inspection of purchasers, *viz.*, agents of filatures, or brokers. First, the "Kakeme" is settled and lot by lot, cocoons are knocked by the committee of 2 or 3 persons appointed by the guild for that purpose to the highest bidder. In such cases, payments are made to the guild by the filature or broker to the extent of 80 per cent of the total amount. The balance is paid for, after actual test reeling is made for percentage of silk and reeling quality. This test reeling may be made in the prefectural station, or in any one of the accredited filatures agreed upon by the selling guild and the purchaser. For all such transactions, the guild charges a small commission of Y. 0·25 per Y. 100·00. In some guilds even this is not charged for. Test reeling is done for 400 momme of raw cocoons (1 momme = 3·75 grammes). Again, the purchases may be effected through brokers. This system has all the drawbacks of the existence of a middle-man, who is unscrupulous. The broker may merely negotiate for particular transactions, or he may purchase cocoons himself and sell to filature. Generally, he has his own godowns to store cocoons. The rearer brings the cocoons and after settlement of bargain, leaves the lot with the broker. He is licensed by the Governor. He has to pass a practical examination held in experimental station, *re.* quality of cocoons, reeling, sericultural laws, knowledge regarding distinguishing cocoons of various varieties of silk-worms and other practical things. Restrictions are imposed to see that abuses are minimised. The one standing complaint against the broker is that he mixes bad and good cocoons.

There is another kind of market, *viz.*, a number of rearers and brokers may form themselves into a joint stock concern with as much capital as Y. 50,000·00. Such a company has equipment for drying of cocoons partially, and an open hall

for conducting transactions. In the big hall a sloping plank 10′ × 6′ is fixed about 2′ high from floor. On either side of it bidders of cocoon sit. One of the Secretaries of the Company sits at one end, the rearer discharges all his cocoons on the plank. After inspection, each bidder writes his bid in a lacquered cup and keeps it inverted. All these are collected and the highest bidder gets the cocoons. The seller gets a receipt indicating weight of his cocoons, money to be paid to him, etc. He gets his money in two days. The seller has to pay a commission of 0·3 per cent and the purchaser a varying commission of 1 per cent to 1·5 per cent according to the volume of business done. The cocoons are partially dried, *i.e.*, to 50 per cent, and handed over to the purchaser. The seller effects payment within a week's time. This system is an improvement over the purely competitive one inasmuch as every one bids without knowing the bid of the other. The sales are very rapid. It also avoids the mixing of bad and good cocoons as by brokers. Yet, this lacks the scientific aspect, *viz.*, there is no test reeling and cocoons are paid on "Apparent" tests.

All the above markets transact business in raw cocoons only. *Of late, much encouragement and attention are paid to trade in "Conditioned" cocoons.* This method is undoubtedly the most scientific. For this purpose, "Cocoon conditioning guilds" are established. Some of the prefectures have in each county a guild of this type. A typical guild has a capital outlay of about Y. 180,000·00; out of which, about Y. 56, 000·00 are contributed by Government, as a subsidy towards apparatus, etc. The rest of the capital comes from contributions of shares of Y. 10·00 each. The members are rearers and other sericulturists, generally of the same county. The guild has 2 or 3 or 4 sets of big drying apparatus, each drier conditioning about 10,000 lbs. of cocoons a day. There are fire, rat, and moisture proof ferro-concrete buildings for storing cocoons. The rearers bring the cocoons to the guild, which takes the standard sample of 400 momme and sends over for tests to the experimental station. Each rearer has the certificate of his lot of cocoons, a duplicate being retained by the guild. The cocoons are all mixed and "conditioned" and stored in the chambers. When filatures wish to purchase, lots are bargained at the market price determined by index value, etc. The payments are all collected by the guild. The rearer gets an advance to the extent of 70 to 80 per cent on his cocoons. Final payments to each seller are made proportionately to quantity and quality of cocoons. The system of computation is complex; but several guilds have their own indices prepared for this purpose. Nearly, 15 per cent of the trade in cocoons now is in "conditioned cocoons."

Conditioning of Cocoons.

Steaming of cocoons is no longer done in filatures. Instead, hot air cocoon driers are extensively used. In small filatures ordinary chambers of 15′ × 7′ × 10′, built in brick and mortar, are used. These chambers are heated by means of steam pipes laid across the floor. On both the longitudinal walls inside the chamber, fans worked electrically are installed, so as to keep temperature even while working. Trays are charged with cocoons, kept in stands, and confined to an active chamber for a period of 8 hours at a temperature of about 180°F. The cocoons condition well. This system is in vogue even in some big filatures. The chambers are big in such cases. Use of electrical heaters has been found to be very costly, compared to steam heating of air.

High class and up-to-date filatures and cocoon drying guilds all use modern apparatus, such as Tabata, Imamura, Obikawa system, etc. These apparatuses are all, what may be termed, continuous movement of extensive belts driven on rollers. Between Tabata, Obikawa, and Imamura type driers, there are only few differences, the essentials being the same. To describe one is to describe all. The chamber itself is 65′ × 20′ × 15′. At the end of the longitudinal walls on each side, there is a system of rollers on which wire belts to the full length and breadth of the chamber move continuously by means of motion conveyed from a pulley. In each chamber there are five such belts. The entire chamber has iron frame work to support the belts in motion. Cocoons are filled at the top belt which moves from direction A to B, and at the extremity B discharges cocoons over the

next series of belts, which moves in the opposite direction, and from there to third belt which moves from A to B, and from there to fourth one which moves in the direction B to A, and to fifth which moves from A to B, and finally discharges on the receiving platform. The motion of the belt is slow, and it takes practically 8 hours for each lot of cocoons to move from first belt to exit finally. The top layers are kept at a temperature of 170°F., and the bottom layers at 200°F. The chamber has a system of steam pipings. Filatures have been extensively adopting this method of "conditioning of cocoons." One chamber can condition in a day about 10,000 lbs. of cocoons. Guilds where these apparatuses are installed charge about Y. 0·25 per kwan of cocoons for conditioning, or conditioning charges per lb., would be a little less than 8 pies.

The Chiba System of Drier:—This consists of a set of vertical boxes. Each box is 1′ × 6′ × 6′. Cocoons are filled and hot air passes from side to side. It is reversed from side to side periodically. This system has not come into prominence.

The conditioned cocoons are all packed in moisture-proof bags of standard size, and stored in store house. The old type store houses are all 2 to 3 storied buildings of ordinary walls, well ventilated, with racks for keeping bags. The roofing is tiled, but, there is always a ceiling to the top storey. The modern type of stores are all ferro-concrete 2 to 3 storied, double walled buildings, with standard chambers lined with zinc sheet. Great care is taken in storing cocoons, and to see that no fungi attack, and insect and other pests do not destroy cocoons. In the guild store houses, any one can store his cocoons provided they are conditioned. The charges are on a graduated scale according to period of storage, etc.

Sorting and Grading of Cocoons.

These operations are very important. All the cocoons are graded according to crop to which they belong, *viz.*, spring, summer, or autumn, as the quality of cocoons differs considerably for each season. The cocoons are again graded according to varieties, *viz.*, cross breeds, between Japanese X Chinese, Japanese X European, etc. This is necessary as denier of each variety differs, and mixed reeling of cocoons would inconvenience reeling operations, etc., as sizes and shapes vary, and as there is slight difference in shade of colour. Within the same lot, cocoons are sorted for quality by removing inferior ones, deformed, and "Pupa crushed" cocoons. This sorting is effected in several ways. In high grade filatures, there is a special chamber fitted with slanting openings in walls and with wooden holders for cocoons. When cocoons are poured into the wooden holder, they slide on desks whose surface has glass plates illuminated electrically from below. Operatives pick out the above mentioned bad cocoons, and separate out good ones. The good ones are either passed to the stores, or to cooking rooms according to requirements. In other filatures, the operations may be simple, and sorting is done on endless moving belts. It is needless to add that yellow cocoons are always kept separate from white ones. Grading and sorting of cocoons may not cost more than 1 per cent of the total expenditure on costs of production.

Cooking of Cocoons.

This is the most important preliminary operation in reeling, as it affects reeling, and costs of production. Cooking in filature is combined, *i.e.*, cocoons are cooked in one place, and distributed to reelers separately. There is no cooking basin attached to a reeling unit. In small filatures, cooking is done in porcelain basins provided with water supply and steam connections. The basins are cylindrical about 13″ in diameter and 14″ in depth with a false bottom, and a plank cover with handle. There are two methods of cooking, *viz.*, sinking and floating. For lower grade cocoons sinking system is good, and for better grade cocoons floating system is suitable. Measured quantity of cocoons is conserved in cooking basin for 1½′ at 180°F. holding and evenly spreading the cocoons by means of the plank, then, steam is let in gradually to raise the temperature to 210°F. and cocoons are kept at the latter temperature for 3′. The plank is again revolved to

evenly distribute the cocoons, and again (*i.e.*, 3′ after) is removed and cold water is sprayed over the cocoons shutting the steam. Again steam is let in till a temperature of 183°F is got, and operations continue for 2′ or so. Steam is again shut and cold spray done again, and cocoons removed. This is the sinking system in which cocoons contain water inside. In the floating system, the treatment is altogether different. Cocoons are encased in a cage and immersed in cooking basin at 210°F for 30″ only, and transferred to basin at 150°F for 5′, and then to basin at 210°F for 6′, and finally to tubs containing water at 120°F. Floating system is adopted by 70 per cent of filatures, and sinking system by 30 per cent. The merits of each system are as follows :—

Sinking System.	*Floating System.*
Out-put per reeler is less	Out-put per reeler is more
'Boil off' less	'Boil off' more
Rendita good	Rendita not so good
Minor defects few	Minor defects more
Colour is poor	Colour is good

This combined cooking of simple type serves well in small filatures. A combination set of 7 to 8 basins can easily handle requirements of 100 ends in reeling and with 3 girls cooking for Japanese cocoons.

In big filatures, cooking in machinery is the general rule. There are various types of continuous cooking machinery. The essential principle applied is to treat cocoons at differential temperatures for definite periods according to quality of cocoons depending upon season, breed, etc. To accomplish this end mechanically, wooden chambers of rectangular shape and of length varying from 20′ to 25′, and width of 3′ and height of 3′ with the upper surface open are devised, there being three different contiguous compartments of varying lengths, such that, when cocoons in boxes are immersed, they receive differential treatment in each chamber as regards temperature and time. The boxes containing cocoons move in the chambers by automatic arrangements. In the first chamber, the temperature may be 200°F. and in the second 210°F. (*i.e.*, boiling temperature), and in the third 180°F. or so. For sinking system, there is an automatic spray of cold water. These mechanical devices are very essential in all big filatures, as cooking costs on " skilled labour " are considerably reduced, and as large quantities can be dealt with easily, and in comparatively short time. There are various types of continuous cooking machinery. The most important are Nakahara Shiki, Choko Shiki, Wakuda Shiki, Circular Nakahara Shiki, Furni Shiki Kinju Shiki, etc. In Nakahara Shiki chambers are not completely separated; but in Choko, all compartments are well separated. Both are rectangular boxes. Choko is preferable to Nakahara. Quantity of cocoons cooked in a day is about the same in both. In Wakuda's system, the chamber is a cubical box and the arrangement of movement of boxes is singularly well adopted for good treatment of cocoons for cooking. This is the most scientific one, and is a recent introduction. Kijun Shiki is not convenient in handling; but, is very good for high grade cocoons. One continuous cooking machine can cook about 2,500 lbs., of cocoons in a day and can easily serve a filature of 250 basins. An installation would cost about Y. 2,000 to Y. 2,500.

In small filatures, where cooking is done in porcelain combination set, the operations are in the hands of expert cookers. In continuous cooking machinery the operations are under supervision of an expert who starts the work, fixes the timings and temperatures to be given for each lot of cocoons of the day, and routine is done by ordinary cooking girls.

Reeling.

Ordinary reeling machinery is simple when compared to that of European one. The basin is of porcelain with false bottom, and has steam and water connections. Shapes and sizes vary. It is fixed in a table of pine wood. Ordinarily there is no " jette-boutte " system. Instead, there is " button " system. Reels are of about 24″ in circumference. The fixtures are all simple. In a few filatures there may be mechanical end-finding arrangements, the brushes being small and light. The travellers have simple motion. Breaks for each reel may be independent. The

revolution of reels is about 200 metres per minute, and if cocoons are of very superior quality, the revolutions may be 250, and it is never below 170. When velocity is high, elongation decreases, but tenacity improves. The reeler herself knots the breaks in silk thread. In a few filatures separate knotters are also employed.

The button system of reeling requires more skill on the part of reelers. But, the silk is "clean." Jette-Boute system is good for beginners and unskilful reelers, and silk produced is not so clean.

Merits of Japanese basin are simplicity, cheapness, less power to drive, clean silk got on account of button system, re-reeling gives cleaner silk, easy to fit up, and easy to repair. All filatures in Japan re-reel silk, there being no direct reeling. Reeling is done sitting on stools in filature uniforms. Generally four to five ends are reeled. Kanega Fuchi, and Gumma Sha filature basins are all made of metal like European basins. Reeling is done standing. The reels are directly over the reeling basin, and are 24" in circumference. The basin provides for reeling 8 to 10 ends by a reeler. Movement of reels is slow. The jette-boute system is of a peculiar type in which thread passes in a knife edge which keeps the silk clean. This basin is costly, and capital expenditure required for installation is more.

Minorigawa Basin:—This basin is the sole purchase monopoly of Messrs. Katakura Filatures at present. The present day basin of Minorigawa provides for 30 ends to be reeled by one reeler. Ordinarily, one reeler can reel easily 20 ends. Reels are *directly* over the basin, and are made of aluminium, and in two sizes, *viz.*, of $1\frac{1}{2}$ metres circumference, and the other of 24", and are circular. The velocity of thread is 15 metres per minute. There is continuous reeling, *i.e.*, breaks are few as the velocity is less. The small reel silk has to be re-reeled. When there is a break, the reel stops automatically (the small reel). One unit length of basin is $8\frac{1}{2}$ feet, and this has 30 ends. 20 end unit is $5\frac{1}{2}$ feet long. Water in reeling basin is luke warm. There are buttons and jette-boutes. The latter are of a curved knife type. The actual reeling operation is simplified, and very neat. The agglutination of threads is complete. The merits of this basin are that it gives very *even* silk which is the most important factor in classification of silk, as it carries 70 per cent of marks. The highest seriplane panel from Minorigawa gives 95 per cent, while silk reeled in ordinary basins has not gone beyond 91 per cent. The ordinary basin on an average gives 83 per cent seriplane, while Minorigawa gives 90 per cent evenness. In "cleanness" it is just the same as ordinary raw silk. On an average, ordinary basin gives $1\frac{1}{4}$ lbs. of 13/15 denier silk, while Minorigawa gives about $\frac{3}{4}$ of a pound. The quantity of waste is also more. Where high quality is concerned Minorigawa is undoubtedly a distinct advance over the ordinary basin. Messrs. Katakura are now conducting experiments with this basin to reel 320 ends. Results are not yet known. The silk manufactured in Minorigawa is sold in New York to Messrs. Girli & Co

Messrs. Hara & Co., big filature company of Yokohama have manufactured an automatic reeling basin. The ends are picked by electrical feeders. I have not seen this basin as not even Japanese experts have been allowed to see, except Mr. Hachiro Tanaka, who, however, explained the detailed working and added that much is yet left to be accomplished.

Messrs. Boeki Seizo Kaisha of Kobe have very recently manufactured a basin with a tension balance in the "Croissure System." When the denier of thread changes, there is an arrangement in the above balance by means of which rings fall or rise 1, 2, or 3 according as the variation in number of cocoons occurs from the objective denier. The adjustments are possible for deniers ranging from 21/22 to 13/15 only. One person can attend to 40 ends which is possible as the reel motion is slow. These basins have not yet been put to large commercial use. The manufacturers claim a good deal for it. The silk reeled gives high seriplane averages. These basins can be bought in units of ten only. The prices have not yet been fixed. These basins are not yet monopoly of any filature.

Reeling Operation:—The cooked cocoons are kept at a temperature of 100° to 120°F. in a tub by the side of the reeler. The temperature in the reeling basin is about 50°C. for sinking system, and about 55° to 60°C. for floating system. Very small brushes are used by the reeler for picking ends. These

operations are very skilful, as rough handling would mean more silk-waste. The left hand in which cocoon threads are held is always maintained at a uniform height as this has also relation regarding waste. Theads are thrown in two ways, *viz.*: "Cut end" throwing, or "Round end" throwing. The former method gives more quantity, while the latter gives better quality. Cut end throwing is adopted for inferior grade cocoons.

Croissuer:—Generally, 300 twists are given for 13 to 15 denier, and 330 twists for 21 to 22 denier silk. The length of the croissuer varies according to "thread angle" on the pulley system. Ordinarily it is 12″. Proper croissuer is necessary for getting suitable cohesion and tenacity.

Re-reeling.—This is absolutely necessary in Japan as silk is reeled on to small 24″ circumference reels, and the requirements of American Mill Owners are hanks of 147 centimetres. Moreover, the gum on the skeins at the corners has to be removed. Therefore, all filatures have a re-reeling establishment. The reels are of 147 centimetres circumference, and are fitted in stands having necessary friction motion wheels, etc. They are as a rule fitted up on both sides. There are steam pipes for drying the silk on reels as quickly as the operation is done. The small reels from filature are passed over to re-reeling establishment and reeled directly after wetting them to soften gum. Generally, the number of re-reels is 70 per cent of the number of basins in a filature. One girl can look after 8 to 10 re-reels. During re-reeling, number of breaks is counted, and skeins which give more than 6 breaks are rejected for export purposes. Sizing skeins of 225 metres are also taken during re-reeling for testing denier. For calculating average denier of a full skein in institutions, counters are fixed to re-reels which record the total length of the thread in the skein. Knowing the circumference of the reel and other factors, denier of the skein is calculated. This is a more satisfactory way than the usual method of denier test, as the percentage of error is less. Some filatures have adopted this method.

Skeining and Other Operations.

After re-reeling, the skeins are removed, stitched, and passed on to skein making department. Skeins are all *hand twisted.* One operative on an average makes 700 skeins in a day of 10 to 11 hours. The skeins are then passed to dark room having northern sky-lights for inspection. Generally, 70 per cent are passed as first choice, 15 per cent second choice, 10 per cent third choice, and the balance is rejected for export, and used for home consumption. Each skein weighs about 70 grammes. 30 skeins are made into a book of about 2·1 Kgs. in the small hand press, chop tickets inserted, and tissue paper is wrapped, and packed into boxes usually holding 16 such books, netweight, of each box of silk is 9 kwan, each picul=16 kwan=133 lbs., and sent to the exporter at Kobe or Yokohama. Some filatures pack the book into a bale of 1 picul in wrapping paper and high grade double matting.

Costs of Production.

An analysis of cost of production in 1929 from enquiries in various concerns for producing 1 picul of silk is given below. The price of silk per picul then was Y. 1,400·00:—

		Y.
(1)	Cocoon drying, transport (drying 160 kwan of cocoons required to produce 1 picul of silk, rendita being 10)	28·00
(2)	Reeling charges—each reeler reeling 1·3 lbs. per day, 13 to 15 denier silk, at Y. 1·00 per reeling girl for 133 lbs. ..	100·00
(3)	Re-reeling charges	8·00
(4)	Supervision, etc.	22·00
(5)	Boarding and lodging charges of reelers, etc.	35·00
(6)	Fuel, water, etc.	40·00
(7)	Broker's Commission at 1·5 per cent on Y. 1,400·00 ..	21·00
(8)	Packing and shipping charges	6·00
(9)	Miscellaneous expenses, such as insurance, taxes, etc. ..	30·00
(10)	Interest on money for financing purchases, etc., for a period of 6 months at 10 per cent on an average, on Y. 1,000·00 ..	50·00
	Total ..	340·00

		Y.
Deduct:—Cost of Chrysalis—1½ picul at Y. 5·00 per picul.	.. ..	7·50
Double and waste cocoons	.. ..	6·00
Long waste—⅙ of picul at Y. 150·00 per picul	.. ..	25·00
Pellets, etc.	.. ..	2·00
Total	..	40·50
Or	..	40·00

Deducting Y. 40·00 from gross manufacturing charges of Y. 340·00 per picul, the net manufacturing charges were Y. 300·00 in 1929 spring. Since then, silk industry has experienced changes. It is difficult to give accurate costs of production now. Cocoon costs for 160 kwan (this would give 1 picul of silk) at Y. 6·25 per kwan were Y. 1,000·00. This means that raw material costs 75 per cent of the total cost of production.

Tests in Filature :—Sizing tests are quite a routine. Elasticity and tenacity tests are not so common. In advanced filatures like Gunze and Katakura, elongation, elasticity, and tenacity are determined by Scott's Serigraph. Seriplane tests are becoming quite common in filatures, as evenness is the most important test nowadays done. For lustre, colour, etc., silk is inspected in dark rooms. Reelers are more often fined for bad and uneven reeling than rewarded for good reeling. Filatures have their own graduated scales of bonuses and fines.

Housing :—Filatures are housed in ordinary Japanese style wooden sheds. A few filatures are contemplating putting ferro-concrete buildings. There are roof-gable windows. Both sides of the longitudinal walls are well provided with full size glass windows. Even though the sheds are simple, yet all hygienic arrangements are well looked after. The reeling basins are always well lighted. This is possible as the Japanese reels are not encased. 70 per cent of workers reside in filature boarding house. A room of 15′ × 12′ is given for 4 to 5 girls to live together, ordinary Japanese wardrobes being given for each room. Bedding is also supplied by the factory. There is a common mess room. Meals are provided three times a day. The average charges on meals per month are about Y. 8 to 10 per head. This is borne by the factory. In well organised filatures, lodging and boarding arrangements are perfect. In Gunze Filature which is the model factory in Japan, dining hall is common for 800 girls, 4 girls having one table. Food is hygienic, and according to Japanese tastes is better than what girls themselves could afford to. There is a Music School, and a school for continuation classes for education of girls. There are recreation grounds. Hospital and well kept sick rooms are also provided for. In fact, there is nothing in this filature which is not model. In other filatures, arrangements are not as good as in Gunze, but not much fault is to be found with. 30 per cent of the workers live outside filature.

Factory Law.

Recent factory law admits of ten hours of work only. But, in filatures actually eleven hours of work is done. Work commences at 6 A.M., and continues till 6 P.M., with an interval of one hour between 12 NOON and 1 P.M., and with 2 intervals of 15 minutes each, at 9 A.M. and 4 P.M.

Age, etc., of Reelers :—Average age is between 18 to 21 years. Girls below 16 years do not enter filatures. 60 per cent of reelers stay less than three years. 40 per cent stay over three years. In rare cases, they stay ten to twelve years. Absence due to illness on an average is 9 days per annum, and due to other causes, 19 days. Average daily production per day is 1⅓ lb., the highest is 2½ lbs. and the lowest is ⅓ lb. On an average an ordinary reeler earns Y. 209·00 per year. Y. 580·00 is the highest, and Y. 44·00 is the lowest.

Training of Reelers :—All filatures maintain an educational section for training reelers. The actual period of training varies between 3 to 4 months. During the training period, inferior grade cocoons are given for reeling. Once or twice a week theoretical classes are also held to explain the various methods of reeling, care to be taken in reeling, inter-relation of several factors, etc., by one of the supervisors. The Experimental Station women assist experts, go

about the filature, and demonstrate various actual operations. After the training is over, these girls are attached as apprentices to good reelers, then given independent work to reel $\frac{20}{22}$ denier silk, and finally asked to reel $\frac{13}{15}$ denier. *There is an intelligent appreciation on the part of reelers of all the processes of work, and of the important and loyal part they have to play in the silk industry.* There have been practically no strikes in filatures. Training in cooking is also given. Some of them specialise in cooking.

Silk Market.

There are two markets for export of silk in Japan, *viz.*, Yokohama and Kobe. There are about 30 active exporting firms in Yokohama, and in Kobe, about ten. At Yokohama about half of them are foreign exporters. They buy their silk mostly through silk brokers called " Tonya," who are licensed brokers of the Silk Exchange at Yokohama or Kobe. When an exporter buys through " Tonya " or broker, he asks for specifications regarding price, grade, quantity, and delivery, etc. The sales may be ' Spot ' or futures. The futures are but few. The ' Futures ' contract specifies all details and dates of delivery. The " Tonya " charges a commission of 1·5 per cent for his services, to the filatures. There is a Union of Brokers in Yokohama which sets down rules of practice in dealings, etc., for brokers. All the brokers are its members. Deliveries are made every five days, and not in less than units of ten bales (1 bale=133 lbs.). In such a case, prices are fixed every fifth day, *i.e.*, 1st, 5th, 10th, 15th, etc. of the month. This is done by a committee of brokers and exporters. The panel of the committee changes on every price fixing day. Prices for silk are fixed taking into consideration New Yark Stock Market reports, rate of exchange, stocks on hand, mulberry and cocoon crop reports, and such other factors that affect silk prices. The silk whose transaction has been agreed upon is sent over to exporters, or deposited in the Imperial Store House Company. Some exporters have their own fire-proof, etc., godowns. Fifty skeins are taken out from a lot of ten bales and seriplane, winding and other tests are carried on by the testing branch of the exporting firm. Visual tests are also carried on in northern sky-light rooms. After the testing branch approves of the quality, the books are all put into a " Shirt " and bales prepared for shipment. Should the silk prove below the specification, the broker is asked to remove the lot, or a new transaction is effected, if both sides agree to a settlement. The total arrivals in Yokohama and Kobe annually, are about 9 lakhs of boxes (one box = 74.4 lbs.), of which sales for export are about $8\frac{3}{4}$ lakhs of boxes, and about 25 to 30 thousand boxes are for local consumption.

Transactions in Yokohama are 80 per cent, while in Kobe about 20 per cent of the total transactions are done.

Silk Exchanges.

There are two Silk Exchanges in Japan, one at Yokohama (established in 1894) and the other at Kobe established in 1928. The object of these exchanges is to establish an exchange market for transactions of raw silk. The silk exchanges are but one branch of the general exchange for rice, stocks and shares. There are thirty-six brokers on the Yokohama Silk Exchange, and at Kobe fifteen. Each broker at Yokohama deposits a cash security of Y. 40,000·00 while at Kobe, it is Y. 30,000·00. The brokers are all big business men of long standing actually engaged in silk business.

There are two sessions and four calls a day.

First Session	First Call ..	9–20 A.M.
	Second Call ..	11–20 A.M.
After-noon Session	First Call ..	1–20 P.M.
	Second Call ..	2–50 P.M.

At each call opening and closing transactions are done for six months, *e.g.* in November transactions, calls are opened and closed for December, January February, March, and April.

Kobe Silk Exchange quotations on 5th July 1930, were :—

July		August		September		October		November		December	
Opening	Closing	Opening	Closing	Opening	Closing	Opening	Closing	Opening	Closing	Opening	Closing
Sen.	Sen.	Sen.	Sen.	Sen.	Sen.	Sen.	Sen.	Sen.	Sen.	Sen.	Sen.
6.000	6,400	6,000	5,000	5,000	5,000	6,000	5,000	6,000	5,000	5,500	5,000

The quotations are for 10 Kin (1 Kin = 1.33 lbs.) in ten Sen. To prevent gambling, the Silk Exchange puts a limit of variation on daily quotations. The limit is Y. 200·00 per Picul.

The first three days of the year and the last three days, the Exchange is closed. It is closed on National and other Gazetted Holidays also.

Buying and Selling.

All transactions (buying and selling) are by competitive bids. Offers and bids are closed, and are approved by the Exchange by indications of fingers and hands, and clapers. The transactions are all done on the basis of D. grade silk with an average seriplane value of 75 per cent or over. Actual deliveries against transactions are about 5 per cent of the total done on the Exchange. The inspection on the Silk Exchange is very strict. Only 70 per cent of the total bales submitted are approved.

Through the Exchange the broker demands of his client to fill in margins which are of different kinds. Margins may be in cash or approved securities. Initial margin to the extent of about 50 per cent is required to be deposited when sales or purchases are to be effected. When the market goes against the client to the extent of more than half of the deposited margin, then the client is required to deposit a supplementary margin. Half of this must be in cash. Additional margins are called for when the market is in violent fluctuations. This is both from buyers and sellers, and one half of additional margin should strictly be cash.

Broker's Commission:—This varies according to price of silk for ten Kin, and according to period to which contract relates. This varies from Y. 0·35 to 0·85 Yen according as the price of silk is Y. 90·00 or Y. 210·00 per 10 Kin, This is for a period of three months. Cheaper rates of commission are charged for near months. The commission covers charges for opening contracts, or cancelling them by buying back or selling out.

Delivery against Future Contracts:—A future contract is fulfilled by actual delivery of raw silk and receiving payment. Or the contract may be cancelled by buying it back, or selling out. In the latter case the difference in price should be paid or received according as the case is. Delivery is admitted either at the Exchange, or one of the two approved Store Houses. Delivery is made on the date of delivery agreed upon between seller and buyer. Visual inspection of silk is made by the Exchange, and mechanical tests for grading are made by the Conditioning House. A fee of Y. 18·00 is charged for a lot of 10 bales (*i.e.*, 1,333 lbs.), and an additional Y. 10·00 is charged for "conditioned weight certificate." When a delivery of non-certified silk takes place the seller has to pay the buyer a penalty of Y. 100·00 per lot of ten bales (*i.e.*, 1,333 lbs.). The seal of certified silk must be in tact. Delivery should be made in 1,000 Kin (*i.e.*, 1,333 lbs.) or in multiples thereof, but an excess of 20, or deficiency of 30 Kin is permissible. In case of a greater variation than the above, the seller must compensate for the variation within three days of the date of delivery.

Grading:—This is in accordance with the Conditioning House classification which will be mentioned later on. For the present it is enough to give the following table that indicates the grading:—

Grade	13-15 Denier (White)						20-22 Denier	
	A	B	C	D	E	F	W (White)	Y (Yellow)
Seriplane—								
Average value not under.	87	84	80	75	70	65	80	80
Average Denier.	13·70	14·50	13·60	14·60	13·50	14·50	20·50	21·50
Winding: maximum number of breaks.	5	5	6	6	7	7	4	4

Average value is got by results of tests for evenness, size deviation, and cleanness, whose relative importance is 50 per cent and 25 per cent, respectively. Since all transactions are based on D. grade, a differential for prices of other grades is also necessary. This differential is fixed every year in January. But, when the differential varies much from actual transactions, the exchange revises the differential to be as near the actuals as possible. The differential fixed in 1929 is given below:—

13/15 Denier White.	A.	Grade on Y. 50·00 (*i.e.*, more than D. Grade).	
	B.	Grade on Y. 30·00.	
	C.	Grade on Y. 10·00.	
	D.	=	Basis.
	E.	=	Off Y. 20·00.
	F.	=	,, Y. 40·00.
20/22 Denier.	W.	=	Y. 150·00 less than basis.
	Y.	=	Y. 150·00 do

The Silk Exchange is a great factor in stabilising silk prices on the market, which have a great influence on cocoon markets. Its importance is felt in the raw silk industry considerably.

Silk Conditioning and Tests.

Law compels that all raw silk to be exported from Japan should be conditioned. There are two Conditioning Houses, one at Yokohama and the other at Kobe. The former belongs to Imperial Government and is a very old one. Kobe Conditioning House is one a Municipal and was established in 1924. The Conditioning House at Yokohama is a ferro-concrete four-storied, brick veneered building costing nearly fifty lakhs of yen. The Kobe House is smaller. The first floor is reserved for receiving bales, and for finding gross and net weights of bales received. The remaining three storeys are all used for conditioning, and other tests and for research laboratories and library. The work in both the houses is just the same. In Yokohama, research work is also carried on. There are two departments in each house, *viz.*: Conditioning Department and Quality Test Department.

Conditioning Department:—In Yokohama there are 128 electrically heated ovens. Most of these are of Messrs. Kawanishi Manufacturing Company of Kobe. The ovens can be kept at 130° to 140°C. constant. There is a side oven in which skeins of silk may undergo preliminary heating which cuts down time of operation. To avoid handling of small weights a chain balance is provided for. Four ovens are connected together by a system of draft chimneys operated by an electrical fan. There is a basket by means of which skeins to be operated upon are hung loose. These ovens are as good, if not better than the Swiss make. The price ranges between Y. 800 to Y. 1,000·00. Silk is received in losts of ten bales. Gross and net weights are found out. From four bales (out of ten bales) 32 skeins, 8 from each bale are indiscriminately drawn out, separated into two divisions A and B, and register number given and passed on to "conditioning" section.

Four skeins are consigned in each basket of the oven at 130° to 140°C. One girl can attend to 4 desiccators at one time. The original and absolute weights are recorded, and skeins passed on to a skeining department where they are skeined and finally handed over to the owner. There are index books for finding out conditioned weights. In 30′ one set of 4 desiccators can determine "condition" weight of 1 lot of silk, i.e., of 10 bales. The capacity of Yokohama Conditioning House is for 2,000 bales a day. Should there be a difference in conditioned weight of over ½ per cent between A and B sections of the same lot, a a third test is repeated. The total number of conditioning tests carried at Yokohama in 1928 was 42,593 representing 405,793 bales. The total conditioned weight was 25 million Kilos. Each bale is charged for Y. 1.00, *i.e.*, a lot is charged for Y. 10·00. This charge is recovered in the form of stamps.

Quality Tests:—These tests are optional and are useful in indicating grade of silk, etc., which facilitates transactions, and the tests having been done in a Government Institution are reliable.

Winding Test:—Though this is not the most important test, yet it is done first to facilitate operations. 50 skeins are taken at random from the 10 bale lot (from 4 bales), 25 are wound from outside, and 25 from inside for 1 hour, the speed being 150 metres per minute. The number of breaks is counted and due entries made.

Seriplane Test:—This is the most important quality test as it determines evenness, cleanness, and neatness which are so essential in weaving mills. In Japan, there are two tests called test A, and test B. In America only B test is carried on.

B. Test:—On a Seriplane which is a black board of about 5′ length, and of a total round of 1 metre, silk is wound from bobbins received from winding branch. The seriplane winding machine has fine adjustments by means of a side gauge. Silk is wound uniformly, and can be adjusted according to denier. For instance 13 to 15 denier silk is wound 500 pieces, while 20 to 22 denier silk is wound 400 pieces on the panel. Each board has 10 panels. 100 panels are examined for determining the final average. This test is done by comparing the evenness of silk wound on the board with standard photographs under "Head Light" in a dark room or a white room, the latter being the more modern method. The average of the results of examination is mathematically worked out from entries. In calculating the average evenness, regard is had to penalty percentage also. The seriplane B test is an invention of Fredrick Schimitsa of Messrs. Chenai Brothers of United States of America.

Seriplane Test A:—After examining for test B and for cleanness and neatness tests, the seriplane boards are passed for test A. This is done for 100 panels. A hand serimeter is used for testing evenness in terms of tenacity which is directly recorded for each thread drawn out by the hand serimeter by a girl. Entries are made for such panels for which penalty is to be recorded. Penalty is calculated by awarding points for low and high extremes for each kind of thread. The average of two panels is got and entered. One girl can do 100 panels in 10′.

Size Deviation:—From the bobbins 200 sizing skeins are wound, and sizes are recorded. Mean deviations and size deviations are calculated, and the total average size is always found out.

Cleanness and Neatness:—Panels are examined for cleanness and neatness for major and minor defects. Major defects are all ticked against with two points and minor defects with one. Then averages for each are calculated and entered.

Tenacity, Elongation:—Tenacity and elongation are found out from Scott's Serigraph for 200 sizing skeins, each time determining for 10 sizing skeins.

Cohesion:—This is found out by the number of strokes necessary to just open the silk thread. The average number of strokes is got by recording the number of strokes in each case, then adding and dividing by the total number of samples under inspection.

A "*Composite result*" table is prepared under various heads and percentage points are allotted by reference to a table. The composite percentage is found

out and the grade of silk is determined. For grading, the essentials are evenness Tests A and B, average low panels, cleanness, neatness, and size deviation. Winding, cohesion, tenacity, elongation, and average size tests are also recorded; but they are not taken into account for grading.

Visual Tests:—These are done both for the lot and individual books. For lot, only quality and finish is recorded. For books, quality, colour, lustre and nature are recorded. These tests are also fairly elaborate.

Prefectural Conditioning Houses:—Besides the two Conditioning Houses at Yokohama and Kobe, there are small Conditioning Houses in some prefectures, like Fukui, Ishikawa, and Kyoto, etc., for conditioning of silk for home consumption. The equipment and methods are the same. Only the latter houses are of a small magnitude. Fukui prefecture has not only one Conditioning House at the headquarters, but, has a few in counties to facilitate work. Fukui and Ishikawa are great weaving centres, and there is considerable transaction in raw silk. These test houses carry on not only conditioning, but also quality tests. The existence of these prefectural houses ensures fairness in trade, and indicates importance paid to quality of raw silk in manufacture of cloth.

The number of evenness tests carried on in Yokohama is about 1,500 under test A, and about 30,000 under test B. Besides, special tests to the extent of 15 thousand are conducted. It is seen that the number of B tests that was over a lakh in 1922 has fallen down gradually to 30 thousand. This is due to the fact that exporters are having their own quality test departments.

Even with the large number of tests that are carried out, the American consumers contend that the number of tests is so small, that the averages got cannot be safely relied on. Against this, Japanese have proved by working on theory of probability of error that the number of tests as carried by them is quite sufficient. Final decisions have not yet been arrived at. After all, America is consumer and Japan may have to yield at least in some respects.

CLASSIFICATION OF SILK.

14 Denier :—

National	A.	B.	C.	D.	E.	F.	White 21 Denier W.	X.	Yellow 21 Denier Y.	Z.
New York	Superior Grand XX	Grand XX	Special Crack XX	Crack XX	XX	Best X	Grand XX	Special Crack XX	Grand XX	Superior Classical XX
Seriplane Test B %	Over 88	Over 85·6	81·2	77·8	75·6	Below 75	85·6	82·3	85·6	82·3
Cleanness % ..	Over 90	85-80	85	80-85	75-80	Below 75	90	85	90	85

This is the classification agreed upon between Japan and Ameria. *Japanese classification is more scientific than European grading, as seriplane is indispensable in America and Japan, and that size deviation finds a very important position.*

Hand and Foot-Reeling.

Besides reeling in filature, there are still as many as 62,088 hand or foot-reel establishments. The total number of basins is 85,363, producing about 40 lakhs of pounds of silk annually. The hand reel is a simple machine. It is worked by one hand, and the reeler uses the other hand for reeling. The cocoons used for reeling are very low grade ones. The foot-reels have a foot pedal for conveying motion to reel. The reeler works with both hands, and uses buttons,

and the croissuer is good. Cocoons of not bad quality are used. Both of these are cottage industries. Generally, the raiyats reel their own silk, or sometimes low grade cocoons may be purchased and reeled. The total quantity of waste produced is about 13 lakhs of pounds. Out of this, about 60 per cent is good long-waste called "Kibisso." The silk is mostly for home consumption. Some quantity is exported to India, but it is negligible. Prices of this silk depend upon market prices of filature silk, and cocoon market. Generally, its price varies between 65 to 70 per cent of the filature silk.

Doupion Silk.

Japan rears univoltines and bivoltines, and the percentage of double cocoons is between 9 to 10. Annually about 7 crores of pounds of double cocoons are produced. When the price of ordinary cocoons was Y. 6·00 per kwan, double cocoons were sold at Y. 2·50 to Y. 3·00. The total number of double cocoon reeling establishments is about 10,000, with 31,832 basins, and with a total production of about 55 lakhs of pounds of silk. An appreciable quantity of the silk is imported into India, and competes with Mysore silk. The quantities of import of this article into India are gradually on the increase. Its price is generally 50 per cent of filature silk. Doupion silk compares very favourably with our charka silk in quality. Very little of modern machinery is employed in reeling doupion silk. Big establishments may have 50 to 300 basins in one filature. Some filatures use modern basins. In small establishments hand-reels are used. Cocoons are cooked for longer period. Generally, 25 to 26 denier silk is reeled. On an average a reeler gives 100 momme of silk (*i.e.*, 4/5 lb.) working 11 hours. The rendita is between 10-12. Reeler is paid for generally according to quantity of silk produced. On an average a reeler may get Y. 0·50 a day. The chief reeling centres are Mæ-bashi in Gunma Prefecture, and Toyohashi in Shizuoka Prefecture.

Silk Waste and its Utilization.

Total quantity of waste produced in Japan is about 3 crores of pounds, and is 33 per cent of the total quantity of silk. Of this, 85 per cent is filature waste, and the rest is from hand-reel, foot-reel, and doupion establishments. In wastes, the following are included in Japan. Prices quoted are all for spring season. (1930).—

(1) *Degara*:—These are pierced cocoons and cost about Y. 300·00 per Picul of 133 lbs.

(2) *Agari Mayu*:—These are unreelable cocoons in the reeling basin. These form about 2 per cent. Cost Y. 100·00 per Picul.

(3) *Kibisso*:—This class includes long waste, and other wastes got in reeling, and brush waste also. Costs vary from Y. 150 to Y. 300·00 per Picul.

(4) *Bisu*:—This is got by collecting thin layer of silk over pupa. Very poor grade waste. cost Y. 70·00 per Picul.

(5) *Kirigara*:—Cocoons cut in filatures, etc., during quality examination. Cost is Y. 300·00 per Picul.

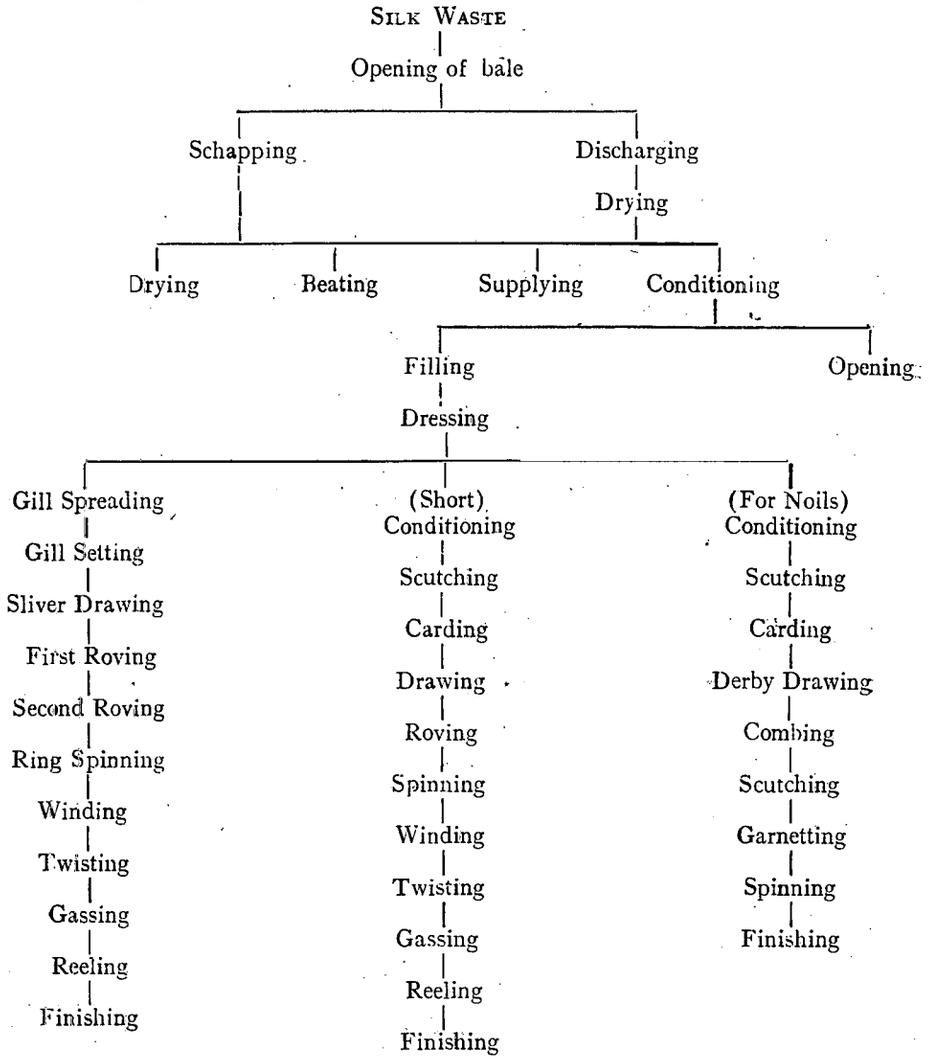
(6) *Kaba*:— French Bourease. Floss converted into noils. It forms 1 per cent of the total waste. Costs Y. 400·00 per Picul.

(7) *Kuzu-ito*:—This is waste silk got in re-reeling. This forms 1 per cent of the total quantity of raw silk. Costs about Y. 400·00 per Picul.

The prices given above are relative. Since spring, there has been considerable decline in prices of silk-waste. Nowadays, about 80 per cent of the total quantity of Japanese silk-waste is consumed in Japan, and about 20 per cent is exported. There are altogether 360,000 spindles in silk-waste spinning establishments.

Manufacturing:—As a rule high grade wastes are used separately from low grade ones. In some factories there is mixing of ordinary and low grade raw materials. Of the two methods of first treatment "Schapping" is very little done. Scouring and discharging are commonly practised. Schapping is avoided mainly because, that in inoculating bacteria other bacteria than fermentation

bacteria also find place in schapping pots. Where schapping is done pots used are of small size. Below is given a table of operations:—



After opening bales, material is opened; and dirt, etc., is removed. Then, follow the process as per above table according as the material is noils, long, or short drafts.

Schapping:—This is done in porcelain pots of 2′ diameter, and of 2 feet in height. The material is allowed to ferment for 3 days at 35°C. Pots outside are surrounded by hot water jackets.

Discharging :—This is done in copper cauldron which contains hot water, and is steam heated. About 200 lbs. of waste is put, water added, and weak boiled for one hour, adding 5 per cent of marseilles soap, 2 per cent of soda. The material is taken out and washed in cement tanks and submitted to another boiling with 10 per cent of marseilles soap and 1 per cent of soda. Next it is washed in cement tank, and again in washing machine till soapy feel is completely removed. Water is completely wrinsed out by hydro-extractor. The material is now dried in a room at 85°—90°C. After the material dries, it is spread out evenly, and soap solution (15 per cent, variable) is sprayed till proper condition is obtained. For each subsequent operation there are engines to which the material is subjected as in spinning cotton. But there are differences between cotton and silk-waste spinning. The needles and porcupines on several engines differ.

200 lbs. of Japanese long waste after discharging and drying reduces itself to about 140 lbs. After "conditioning" it becomes 165 lbs. Subsequent to conditioning in 'opening', 'filling', and 'dressing', it reduces to 100 lbs. Again it loses about 2 lbs. in picking, gill spreading, setting, drawing, roving, and spinning. After doubling, twisting, and gassing, it reduces to 90 lbs.

Erection of Factory.

The main engine on which calculations are made in erecting a factory is spinning frame. Each spinning frame has 300 spindles and can produce in 8 hours 15 lbs. of 135 count yarn. Assuming 200 lbs. production of yarn per day for a factory to work on commercial lines, the following would be the requisites:—

1.	Opening engines	.. 2	Can handle 400 lbs. of waste.
2.	Ordinary filling engines	.. 3	Can handle material from 2 opening engines.
3.	Small filling engines	.. 5	Each can handle about ½ the material from No. 2
4.	Circular draft engines	.. 10	Each handles ½ of the material from a single small filling engine.
5.	Gill spreaders	.. 8	The number of this, is less than circular draft engine.
6.	Gill sett frame	.. 4	½ that number.
7.	Drawing machines	.. 5	

But adjustments in working would be possible, if double shifts are arranged for some processes.

A temperature and humidity regulating apparatus would also be necessary. Besides the boiler for use in 'discharging' operation, water supply, motor power for driving the several engines is necessary.

The erection of a silk-waste spinning factory in Mysore deserves sympathetic consideration.

Silk-Waste Trade.

Factories and exporters purchase through brokers in Yokohama and other centres. There is no scientific grading of silk-waste. Japanese waste may be said to be good inasmuch as bad practices are but few. Some of the biggest manufacturing firms are Messrs. Kanegafuchi, Messrs. Fuji Gasu Boseki, and Messrs. Showa Mills. An appreciable quantity of silk-waste yarn is being imported into India. Messrs. Mitsui are agents of some of the above big companies.

The recent report of Messrs. Osaka Kikai from Japan on the behaviour of our silk-wastes in actual operation is very encouraging.

Artificial Silk.

A careful survey of world's production of natural silk and also of artificial silk indicates that the production of natural silk has in no way suffered. It is true the phenomenal rise in manufacture of artificial silk has directly influenced prices of raw silk to an appreciable degree.

There are several processes by which artificial silk is manufactured, *viz.*: Viscose, Cellulose-acetate, Nitro-Cellulose, Cupro-Ammonia, and Chardonette. Viscose is the cheapest, but the quality of artificial silk is not so good. Cupro-Ammonia process gives good quality artificial silk. Chardonette is very costly, as considerable quantities of ether and alcohol are used. England employs both Viscose and Cellulose acetate ; nitro-cellulose process is employed largely in Belgium and America ; Germany has cupro-ammonium process. In Japan, it is practically all Viscose. There is no admission to factories. Uyeda College, where I worked for silk-waste spinning, and for manufacture of artificial silk, is the only place where one can see the processes.

Manufacture of Artificial Silk by Viscose Process:—Caustic Soda lye of 15 degree strength is filled in iron tanks kept at a height of about 10′ from the ground level. The tanks are maintained at 18° to 20°C. and have temperature regulators. From these tanks soda lye is discharged by means of a pipe to an iron tank containing a cage which holds wood pulp in the form of pressed boards. These boards are just covered with soda lye and allowed to remain for 2 hours. The soda lye from boards is now pressed out by means of a press, and the pressed out soda lye is transferred to a mixing tank kept under the supply tank to which it returns. From the pressed condition, the material is transferred to a "Kneading machine" worked by power by means of a shaft. The material is here

crushed and powdered. This substance is transferred to a "Ripening box" (Alkali-Cellulose), and is spread for three days at a constant temperature of 18° to 20°C. This ripened alkali-cellulose is transferred to a "Sulphidizing" chamber, where carbon-di-sulphide is added at the rate of 35 to 40 grammes per 100 grammes of dried cellulose (or 310 grammes of pressed alkali-cellulose). The whole is now churned for 2 hours at 22° to 33°C. (At the beginning the temperature is 22°C and gradually it rises to 30°C. due to chemical action.) The substance now assumes colour of the yolk of egg. This is xanthate which is transferred to dissolving machine containing 17 per cent NaOH solution. The solution made contains 8 per cent of cellulose, 7 per cent of NaOH, and 85 per cent of water. This is calculated each time. This dissolving machine is connected with a cooling apparatus for constant temperature of 16° to 18°C. Dissolving continues for 4 hours, and very large power is required for this operation. The material is now submitted to "after ripening" process. It is sent to pressure tanks from which it is pressed into filter press from where it is pressed to "spinning tank" with compressed air. The fluid is forced through "filtering candles" having glass tubes which have spinneretes attached to it. The filaments as they come out coagulate in a bath containing 10 per cent H_2SO_4, 5 per cent Glucose, glauber's salt (300 grammes per litre), and zinc sulphate at the rate of 70 grammes per litre. The tube dips into the bath, the thread floats. This is picked, passed over a guide, and then to glass funnel, and then into centrifuge boxes rotating at 5,000 to 6,000 revolutions per minute. The spinning velocity is 40 to 45 metres per minute. In making 150 denier artificial silk centrifuges are removed every 70′ to 80′, and contents discharged and reeled into hanks.

The sulphuric acid bath is absolutely necessary and is kept at 40°C in constant circulation. The hanks are washed under water spray for 24 hours, then dried in shade, stretched in a stretching machine, and desulphurized with Na_2S (1 per cent solution) for 30′ at 60°F. They are again washed with water at 20° to 30°C, bleached with sodium hypochloride solution (strength of active chlorine being 0·7 per cent to 1 per cent) for 20′, and again washed with water. They are treated with hydrochloric acid of 1·5 to 2 per cent strength for 20′, washed, treated with Marseilles Soap, or Olive Oil emulsion. During this process hanks are hung on "ebonite" pegs. After oiling, hanks are submitted to hydro-extractor. The denier depends upon speed of delivery, and viscocity of solution. The most important manufacturers of artificial silk in Japan are:—

1. Messrs. Nippon Rayon and Company.—This factory has a capacity of 6,000 to 7,000 kilos per day.
2. Messrs. Teikoku Jinzo Kabushiki-Kaisha.
3. „ Toyo Rayon and Company.

Prices ranged between Y. 1·30 to 3·50 for artificial silk of 250 denier to 260 denier in May.

A large quantity of artificial silk and its products are imported into India from Japan.

Wild Silk.

There are two kinds of wild silk-worms that are raised in Japan. Antherea Yamamayi and Antherea Pernyi, the local names being Tensan and Sakusan, respectively. The former is chlorophyl green in colour, and the latter is brown resembling tassar in several respects. Tensan is reared on Quercus Serrata, (Japanese name being Kunugi Nara). Sakusan can be reared on Quercus Serrata, Quercus Mongolica, or Quercus Dentata. These are reared in hilly districts, largely in Nagano and Ibaragi prefectures. Quercus Serrata is cultivated by raising seedlings and planted in roughly prepared land at 6′×6′ during spring. Bushes are allowed to grow between 4′ to 6′ only. Every year there is pruning done between December and March. The crop is available three years after planting. The total area under cultivated oak is about 1,300 acres and that mostly in one county of Nagano prefecture. The total quantity of Tensan and Sakusan cocoons in 1918 was about 12 millions, which fell to 5 millions in 1921 and rose to 12 millions in 1929. Of this, 33 per cent were Tensan and the rest Sakusan. The fall was due to pebrine and fly pest. Pebrine is now controlled by examining female moths in the Local Inspection Station. 100 cocoons give

momme of silk, *i.e.*, it takes about 1,800 cocoons to produce one pound of silk. In one acre, one can get only about 8,000 cocoons or just as much as to produce only 4½ lbs. of silk. The total value of silk of Tensan is about Y. 92,000·00 and that of Sakusan Y. 60,000·00.

It (Tensan) is a univoltine and is reared in spring. Eggs pasted on strips of paper are tied to branches of the plant. Young worms hatch and feed at "Vira." Generally, eggs are tied about the 10th of May to the branches of the oak bush. The larval stage lasts for 50 days. The pupal stage takes 7 to 10 days, and 7 to 10 days are taken for moths to cut out, if cocoons are preserved for seed purposes. Cocoons for seed are arranged with "ends on" for moths to emerge. One female and one or two males are let in a conical bamboo basket with wide meshes and the open end is closed by means of paper and string. The pairing lasts from evening to evening when eggs are laid. The seed baskets are hung up in rows in an open shed and kept till the season comes in. After the moths die, males are thrown away and females are removed, numbered, etc., for examination. In early spring, eggs are scraped, washed and subjected to a temperature of 40°F. for 20 days, removed, pasted on papers and tied to branches of oak bushes. They hatch in ten days afterwards.

Seed cocoons cost Y. 0·03 and reeling cocoons Y. 0·015 each.

Reeling is done without any preliminary cooking. Ordinary basins are used. One reeler can produce 50 to 70 grammes of silk a day. The price of silk in 1929 spring was Y. 52·00 per lb.

This silk is used largely for ornamental designs especially in the broad waist band (obi) for women in Japan.

Antherea Pernyi is a bivoltine, *i.e.*, it gives summer and autumn crops. The treatment is similar in several respects to that given for Antherea Yamamayi. A large quantity of silk of Antherea Pernyi is imported into Japan from Manchuria and Shantung. This silk is cheap. *Experiments are being successfully* conducted on feeding Antherea Yamamayi and Antherea Pernyi on silver oak in Manchuria by the experimental stations of South Manchuria Railway Company.

Silk Weaving.

Silk is woven for export as well as for home consumption. Fukui, Ishikawa, Gumma, and Kyoto prefectures are noted for silk-weaving of various silk cloths, such as Georgettes, Crepes, Plains, and in fact all sorts of manufactures. Mostly, the mills are small factories of 10 to 20 looms. In Fukui and Ishikawa, 200 to 300 looms in a factory are not uncommon. Power looms worked by electricity are the rule. In small factories, twisting, doubling, and dyeing are done in the primitive machinery. In bigger factories, twisting and doubling plants are not uncommon. Or in centres like Fukui, and Kanazawa, large throwing mills are worked by Joint Stock Companies and orders from mills are executed, or the throwing mill may purchase silk, twist and double and sell the throw silk. The Nippon Throwing Company at Kiriyu (a big weaving centre) with 43,000 spindles, is the biggest throwing mill in Japan. *White thrown silk of this mill is exported to Benares.* 5 Horse Power is used for operating 1,000 spindles. (Electric energy costs 5 Sen = annas 1¼ per Kilo Watt). For degumming, 1 per cent Marseilles Soap and 1 per cent olive oil is used. Throwing machinery is manufactured in Kiriyu, but the Italian one is better made.

A typical small scale factory of Mr. Morishima which I saw and where I made a study, has 7 power looms. It weaves mostly "Chirimin" (Rough Crepe). The Horse Power used is only 2. He has a small spooling machine of 10 spools and a winding machine of 50 spools. Twisting is done on ordinary drum wheel. In throwing branch, 13 girls work, and in weaving shed, 3 girls. Each loom gives 22 yards of "Chirimin" a day of 10 hours. His total annual production is 4,000 pieces, each piece selling at Y. 20·00. Degumming and dyeing are done in his own factory. To his Co-operative Society for tests, etc., he pays Y. 0·80 a piece. His net income after allowing for depreciation and other charges is Y. 2,000·00 a year. This factory may be taken as an average type.

Silks manufactured in Japan are exported to several countries of the world. India imports a very large quantity of plain silks, as well as prints, crepes, etc.

All silk piece goods to be exported have to be examined and certified *exportable* by Cloth Inspection Station, either Imperial or Prefectural, whichever happens to be in the jurisdiction. There is a guild for factory owners. This maintains a Test House for piece goods to be consumed in Japan. The tests conducted are yardage weight, surface defects, and number of warp and weft defects. Silkweaving Industry is a very flourishing one in Japan. There is an Indian Silk (Piece Goods) Merchants' Association at Kobe. Its objects are to safeguard their trade, to get examination made of piece goods, to settle disputes that may arise, to promulgate methods for transacting business, etc.

Sericultural Laws.

The most important laws in existence are the Sericultural Law, and the Regulation for the application of Sericultural Law, Regulations relative to Inspection Stations. The essence of these laws is to see that diseases of silk-worms are kept under control, and that seed production is supervised and licensed. The translations of several laws will be submitted separately.

National Subsidies.

The State contributes towards expenses on various items of expenditure. The National help for prevention of silk-worm diseases is Y. 173,000 annually. The prefectures spend nearly 2½ million yens. To improve mulberry cultivation State aids to the extent of Y. 22,000, while prefectures spend Y. 611,000 annually. Towards manufacture of original eggs of silk-worms the Imperial Treasury contributes Y. 37,000, and prefectures spend nearly Y. 2,000,000. The Raw Silk Association of Japan is helped to the extent of Y. 13,000 by the National Treasury. For investigating and remedying the existing defects State aids to the extent of Y. 1,005·00 to each prefecture, and an additional Y. 1,000,00 is given for investigating certain appointed things. In times of depression the reeling industry is given "subvention" on a large scale just as this year, Y. 3,000,000 were given to stabilize raw silk prices. On the whole, the contributions are generous and given in a way such that the industry or its organization is affected to an appreciable extent.

Future of the Silk Industry.

Artificial silk has been replacing cotton, and to a certain extent has been responsible in bringing down prices of silk. Rayon may even improve further. China is becoming a serious competitor in international silk markets. The future of silk industry lies in improving quality, and cheapening costs, and giving satisfaction to the customers.

Conclusion.

The essential features of organization of silk industry in Japan are that the organization is universal and efficient. The silk-worm diseases are controlled by examining all seed to be used. The seed-makers are all licensed, and well under control of the Government Institutions under Law. Great attention is paid to Sericultural Education to man all Government Institutions, filatures, etc. A large number of trained men from prefectural sericultural and agricultural schools settles down in life as sericulturists. This enables sericultural work to be scientific and rational. Guilds exist separately for each branch of work and appreciable advantage is taken by members of the existence of such institutions. There is a real spirit of co-operation which is strengthened by a live national instinct to compete successfully against other countries. The research work done in improvement of races of silk-worms, evolving of new races, and also of mulberry, better methods of rearing of silk-worms, and cultivation of mulberry, and attention paid to improvement in reeling are potent factors in the rapid development of silk industry. The artificial hatching and standardized cold storages for use of

summer and autumn crops have materially added to the out-put of cocoons and consequently increased profits to rearers and reelers. Exact, accurate, and timely statistics have considerably facilitated work of forecasting crop values. The Conditioning Houses, and Silk Exchanges are important factors. Added to the several factors cited above, the spirit of progress in all directions keeps a healthy atmosphere, as otherwise stagnation would set in. The spirit of team work and co-operation on the part of workers in all institutions has undoubtedly done much in solving new problems, and carrying through work very successfully which otherwise would be very difficult to accomplish. The raiyat on his part has by working hand in hand with the institutions created facilities. The Government have always been generous in responding to all calls from those engaged in sericulture, besides taking initiative themselves in many respects. Above all, the Imperial solicitude for the advance of the industry keeps a stimulus in every one. This Imperial patronage has taken practical shape in actually rearing worms in the Imperial Palace and in raising mulberry nurseries, and this is undoubtedly a dynamic national factor in the life of the sericulturist.

K. SHAMSUDDIN KHAN,

MYSORE,
Dated 25th November 1930.

Assistant Superintendent of Sericulture.
(On Special Duty.)

WD 1046—GBPM—100—7-3-31

General observations.	Suggestions for adoption in Nagpur.	Remarks.
Japan's output of silk increased by 35 times during a period of 60 years. The phenomenal growth is due to increase in mulberry acreage, rearing of autumn and summer crops, introduction of artificial hatching, improvement in silk worm races, improvements in rearing silk worms, scientific researches, etc.		
Factory filatures have largely replaced old home-reeling establishments.		

Filatures are installed, not for commercial purposes but for educative purposes. A large amount is spent on Inspection. Stations which exist primarily for inspection of seed and control of diseases. Filatures in Japan carry on tests of Cocoons and issue certificates.

3 ✓ The Sericultural Law of Japan requires that all silk worm eggs to be reared shall be microscopically examined, and certified to be disease-free

Whether it is possible to [illegible] Indian Legislature [illegible] by Resolution or [illegible]

2. The Sericultural Inspection Station enforces all Seri. Laws, especially those relating to rearing and 'fly' diseases, and advises Sericulturists in matters relating to Seri.; collects statistics, supervises, encourages and forms Sericultural guilds of all denominations.

There are 3 Seri. colleges, and their course of studies is detailed in page 21 of the report.

Japan has got the guild system in all branches of all industries. The Reeling guild - described in p. 3 in 31 Office Report is important guild.

It is desirable to have a guild system in at least for the Export Trade. As to bring them also in to the system of

pull a very big heavy and impure hank in Cocoon-reeling. Good hand can reeling Cocoons (page 31)

6 The work of the Sericultural Association of Japan consists of Researches into Sericulture, Spreading Sales of Japan Silk, Co-operation with other bodies, honouring ~~benefactors~~ of benefactors of Seri. &c. page 34.

7 In warm regions, it is advantageous to have "Bush" Cultivation. Trees are prone to pests. Tree leaves are superior in quality. The Tope system of propose has a great economic and climatic advantage.

Japan Sericultural Association is a guild or organisation to ~~with~~ address Cocoon rearing and conditioning ~~may be held~~ necessary.

The propose silk Association has a Combine in Italy the functions of Raw Silk Association as well as Seri. assoc.

~~Real reasons are needed to replace~~ propose has too long ~~Japan following~~ cutting planting method which ~~is~~ the worst ~~that exists~~ the concept of this method ~~should be displaced by~~ seedling planting, and subsequently by grafts (page 35).

and in Japan here may be mostly

It is necessary to see that too many crops are not harvested, as that affects the vitality of the plant and is also false economy. In Mysore, it is necessary, at least in irrigated lands, to standardise the no. of crops to be harvested. Actual experiments have to be conducted before definite scheme could be given. (page 37).

Rotational method of cultivation in mulberry areas is recommended for upkeep of soil fertility and to prevent deterioration of mulberry plants. pp. 37-38.

10

Hybridization work in respect of mulberry is recommended as being absolutely necessary. It is stated that more land would be necessary for this work in our gardens. (Page 41).

In Summer season, reed frame is put up on either side of the rearing room to keep the temperature cool.

This type of rooms can with advantage be built here. (Page 43)

Baidardi rearers are in the habit of confining Chawki to brass plates and cover it air-tight. This method may be modified into the more Scientific one as in Japan (Page 45)

The use of nets for changing and transfer of worms may be adopted in sericulture with advantage.

Manufacture of reels can be started in the house of sericulturists as a subsidiary occupation.
(Page 45)

In connection with the rearing of worms, it would be necessary in all Govt. farms to minimise the size of trays and rear worms cellularly in the interests of improving the quality of rearing. This (worms) in the beginning increase costs on mulberry leaf, but it would be of great advantage in the end. (Page 47)

It is not prudent to purchase loans and rear excepting in the case of seed cocoon rearers.
(Page 49)

of late, the tendency is to have ferro-concrete buildings with ammonia plants. This is the best type as temperature can be regulated. Such a cold storage would be absolutely essential here.
(page 5-2)

The creation of a silk-waste spinning factory is deserves sympathetic consideration. (page 9 D)

The future of silk industry lies in improving quality and cheapening costs, and giving satisfaction to customers.
(page 9 7)

G.R.S. App. F VI G-2]

SUBJECT .....

.....

.....

Diary No. of letter replied to.....

General and Revenue Secretariat

( )

the *193* .

Date of issue 3 : 1 : 31

Signed by Mr M.S. Rao

May this be

(i) Printed ?

(ii) treated as a standing order ?

(iii) published in the Gazette, English Part?

(iv) translated ?

(v) placed at the disposal of the press ?

(vi) published in the Gazette, Kannada Part ?

Sec. Sec

File No: S.D.

Serial No. 2

Proceedings of the Government of His Highness the Maharaja of Mysore.

Read— Letter no. Q-2131-278 3rd Dec. 1930 from the Dir. of I. forwarding a Govt. note given by Mr K.S. Iyengar, Asst. Superintendent of Govt. Silk Organisation Silk Industry in Jalgaon, and requesting Sanction to get 100 copies of the note printed at the Govt. Branch Press, Mysore

Order 6829-30

Sanction is accorded to the Director of Industries & Commerce to send a copy of the report of the Superintendent of Govt. Silk Organisation, Jalgaon, for record.

108

action.

Sir

M. 1/30 / D Legn

To

The Dir - of

Supdt. Govt. Printing

Copy to Dir of Statistics

120-24-12-30

List of enclosure

Copied by

Examined by

WD 02560 —GPB —11,250 —2-7-30

PROCEEDINGS OF THE GOVERNMENT OF HIS HIGHNESS
THE MAHARAJA OF MYSORE

Extra

Read:-

Letter No.D4-2131-27 dated 3rd December 1930 from the Director of Industries & Commerce forwarding a copy of the note given by Mr. Shamsuddin Khan, Assistant Superintendent of Sericulture on Organization of the Silk Industry in Japan," and requesting sanction to get 100 copies of the note printed at the Government Branch Press, Mysore.

Order No.D. 6829-30/Sri 58-30-2

Dated.Bangalore. 3 January 1931.

Sanctioned; the Director is requested to send a copy of the report to the Superintendent Government Printing for needful action.

M Ramachandra Rao

For Secretary to Government,
Development Departments.

To

The Director of Industries & Commerce in Mysore.
The Superintendent, Government Printing.

D.D.4-2/1.

110

G.R.S. App. F VI G-2]

SUBJECT .....

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Diary No. of letter replied to.....

General and Revenue Secretariat

( )

the *193* .

Date of issue 7.3.31

Signed by Jur Mrs. RRao

May this be

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(iii) published in the Gazette, English Part?

(iv) translated ?

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2 Copies

Sec. Seri.

File No. S 8-30.

Serial No. 2

Proceedings of the Government of His Highness the Maharaja of Mysore.

Read— Letter no. D4-2131-27 dated 3rd Dec: 1930 from the Dir. Sc. forwarding ~~copy~~ a note on "Organization of Silk Industry in Japan" prepared by Mr. K. Shamanadhan Iyengar Asst. Inspr. of Seri:

Order Thereon No. D8756.

Received, ~~with the observation that~~ Govt. have perused the report with interest. ~~Govt. observe that~~ Some of the points referred to in the report require to be furnished by the Dir. & requested to take necessary action in this

e.g. Those as referred to in his appendix.

To keep for
headings and Govt. may
be glad to have be kept
informed periodically about
the action taken by the Govt.
to bring the various amend-
ments in force.

17.2.31

17/2

17.2.31

Do

the Dir - Dr

17.2.31

VB. 14/2/31.

List of enclosure

Copied by

Examined by

WD 02560 -GPB --11,250 --2-7-30

Points in Mr. Shamsuddin Khan's Report.	Remarks.
Filatures on Factory basis have largely replaced old home reeling establishments. Filatures are installed not for commercial purposes but for educative purposes. A large amount is spent on inspection stations which exist previously for inspection of seed and control of diseases. Filatures in Japan carry on tests of co-coons and issue certificates.	The feasibility of encouraging the starting of one or more filatures with silk worm rearing centres may be examined by the Department.
2. The Sericultural Law of Japan requires that all silk worm eggs to be reared should be microscopically examined and certified to be disease free.	Whether it is possible to introduce such a system for Mysore either by legislating or by executive action may be considered.
3. The Sericultural Inspection Station enforces all sericultural Laws, especially those relating to pebrine and fly diseases, and advises sericulturists in matters relating to Sericulture, collects statistics, supervises, encourages and forms sericultural guilds of all ~~demonstrations~~ denominations.	
4. Japan has got the guild system in all branches of all industries. The Filature guild - described in pp 30-31 of the report is an important guild.	Is it desirable to have such guilds, at least of the Domestic Unit owners.
5. With a view to ~~increasing and~~ improving trade in conditioned cocoons, Govt. have been encouraging cocoon drying guilds (page 31).	~~Such~~ A guild or organisation to introduce cocoon drying and conditioning may be tried.
6. The work of the Sericultural Association of Japan consists of Researches into sericulture, spreading sales of Japan silk, co-operation with other bodies honouring of benefactors of seri etc., page 34.	The Mysore Silk Association has to combine in itself the functions of Raw Silk Association as well as Sericultural Associations.
7. In warm regions, it is advantageous to have "Bush" Cultivation; Trees are prone to pests, Tree leaves, are -- superior in quality. The Tope System of Mysore has a great economic and climatic advantage.	What measures are needed to replace "cutting planting" method now in vogue here may be investigated.
It is necessary to see that too many crops are not harvested, as that affects the vitality of the plant and is also false economy. In Mysore, it is necessary, at least in irrigated lands, to standardise the number of crops to be harvested. Actual experiments have to be conducted before definite scheme could be given (page 37).	

113

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It is not prudent to purchase leaves and rear excepting in the case of seed cocoon rearers. (page 49).

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The erection of a silk waste spinning factory in Mysore deserves ~~sympathetic~~ consideration (page) 90).

The future of silk industry lies in improving quality and cheapening costs, and giving ~~sks~~ satisfaction to customers. (page 97).

These suggestions ~~may~~ deserve to be adopted as far as possible.

17.2.31

Extra

111

PROCEEDINGS OF THE GOVERNMENT OF HIS HIGHNESS
THE MAHARAJA OF MYSORE

Read:—

Letter No. D.4-2131-27 dated 3rd December 1930 from the Director of Industries and Commerce forwarding copy of a note on 'Organization of Silk Industry in Japan' prepared by Mr. K. Shamsuddin Khan, Assistant Superintendent of Sericulture.

....

Order Thereon No. D 8756/Sei 58-30-2

Dated, Bangalore, the 7 March 1931.

Recorded. Government have perused the report with interest. Some of the points referred to in the report require to be pursued. These are referred to in the Appendix. The Director is requested to take necessary action in this behalf and to keep Government informed periodically about the action taken.

For Secretary to Government,
Development Departments.

140

To

The Director of Industries and Commerce in Mysore.

Mk/2

Points in Mr. Shamsuddin Khan's report.	Remarks.
1. Filatures on factory basis have largely replaced old home reeling establishments. Filatures are installed not for commercial purposes but for educative purposes. A large amount is spent on inspection stations which exist previously for inspection of seed and control of diseases. Filatures in Japan carry on tests of co-coons and issue certificates.	The feasibility of encouraging the starting of one or more filatures with silk worm rearing centres may be examined by the Department.
2. The Sericultural Law of Japan requires that all silk worm eggs to be reared should be microscopically examined and certified to be disease free.	Whether it is possible to introduce such a system for Mysore either by legislating or by executive action may be considered.
3. The Sericultural Inspection Station enforces all Sericultural Laws, especially those relating to pebrine and fly diseases, and advises sericulturists in matters relating to sericulture, collects statistics, supervises, encourages and forms sericultural guilds of all denominations.	
4. Japan has got the guild system in all branches of all industries. The Filature guild - described in pp 30-31 of the report is an important guild.	Is it desirable to have such guilds at least of the - Domestic Unit owners.
5. With a view to improving trade in conditioned cocoons, Government have been encouraging cocoon drying guilds (~~page 31~~)	A guild or organisation to introduce cocoon drying and conditioning may be tried.
6. The work of the Sericultural Association of Japan consists of Researches into Sericulture, spreading sales of Japan silk, co-operation with other bodies honouring of benefactors of sericulture etc. ~~page 34.~~	The Mysore Silk Association has to combine in itself the functions of Raw Silk Association as well as Sericultural Associations.
7. In warm regions, it is advantageous to have "Bush" Cultivation; trees are prone to pests, Tree leaves are superior in quality. The tope system of Mysore has a great economic and climatic advantage.	What measures are needed × to replace "cutting planting" method now in vogue here may be investigated. × Vide pp. 10 & 19 of my S. Kanara tour report.
8. It is necessary to see that too many crops are not harvested, as that affects the vitality of the plant and is also false economy. In Mysore, it is necessary, at least in irrigated lands, to standardise the number of crops to be harvested. Actual experiments have to be conducted before definite scheme could be given. (~~page 37~~)	

Rotational method of cultivation in mulberry areas is recommended for upkeep of soil fertility and to prevent deterioration of mulberry plants ~~pp.37-38.~~ 116

Hybridization work in respect of mulberry is recommended as being absolutely necessary. It is stated that more land would be necessary for this work in our gardens. ~~Page 41.~~

8. In summer season, ~~seed~~ ~~plant~~ Reed plant is put up on either side of the rearing room to keep the temperature cool.

This type of rooms can with advantage be built here. ~~(page 43)~~.

Bidadi rearers are in the habit of confining chawki to brass plates and cover it air tight. This method may be modified into the more scientific one as in Japan.

The use of nets for cleaning and transfer of worms may be adopted in Mysore with advantage; manufacture of nets can be started in the house of sericulturists as a subsidiary occupation. ~~(page 45)~~

These suggestions deserves to be adopted as far as possible.

In connection with the rearing of worms it would be necessary in all Government farms to minimise the size of trays and rear worms cellularly to improve the quality of rearing. This would be in the beginning increase costs of mulberry leaf, but it would be of great advantage in the end. ~~(page 47)~~

It is not prudent to purchase leaves and rear excepting in the case of seed cocoon rearers. ~~(page 49)~~

Of late, the tendency is to have ferro-concrete buildings with ammonia plants. This is the best type, as temperature can be regulated. Such a cold storage would be absolutely essential here. ~~Page 52.~~

The erection of a silk waste spinning factory in Mysore deserves consideration. ~~Page 90.~~

The future of silk industry lies in improving quality and cheapening costs, and giving satisfaction to customers. ~~Page 97.~~

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